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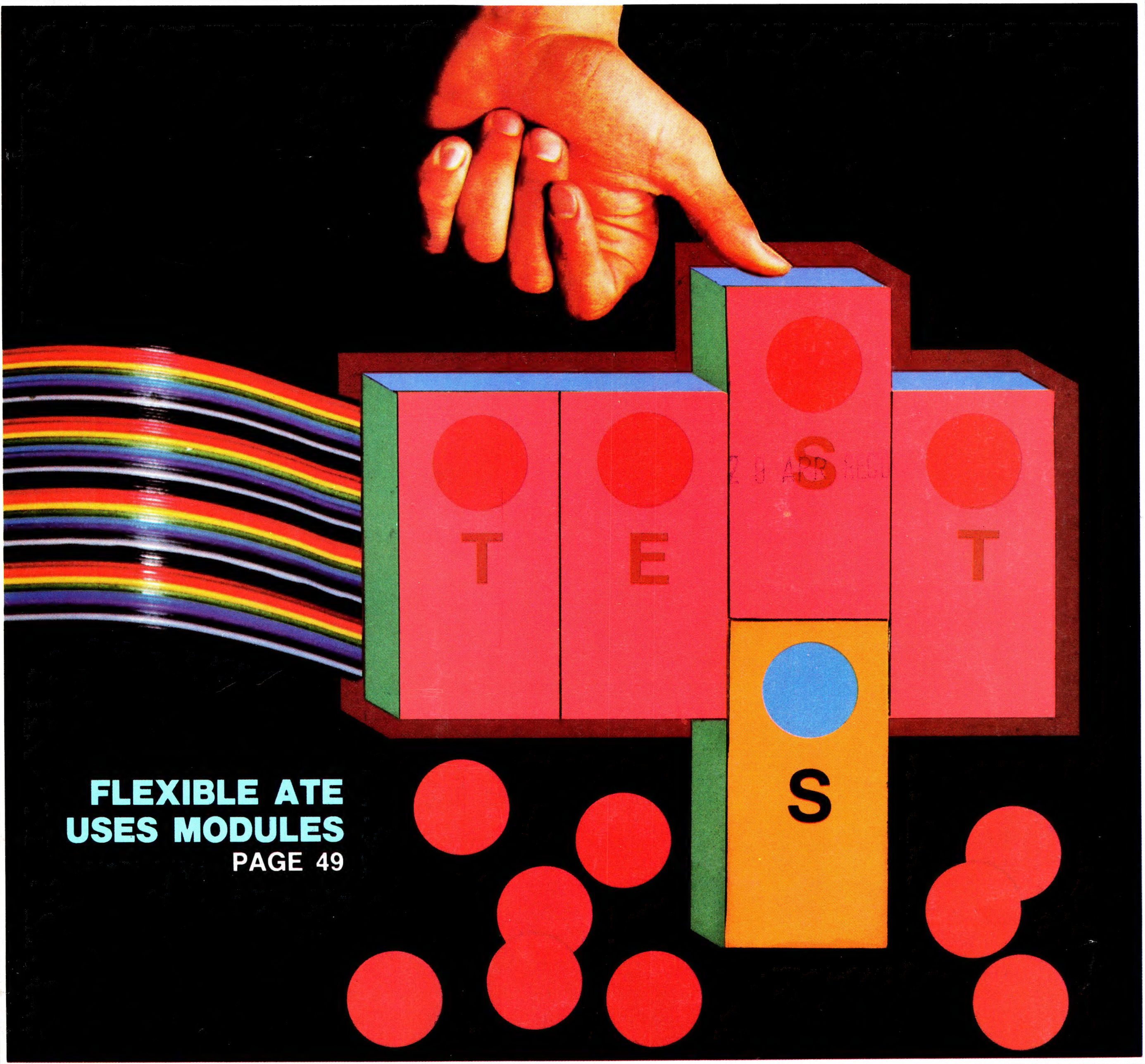
APRIL 15, 1985 $3

ElectronicsWeek®

THE MAGAZINE OF THE WORLDWIDE ELECTRONICS INDUSTRY

CUTTING THE COST OF AUTOMATIC TEST



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FLEXIBLE ATE USES MODULES
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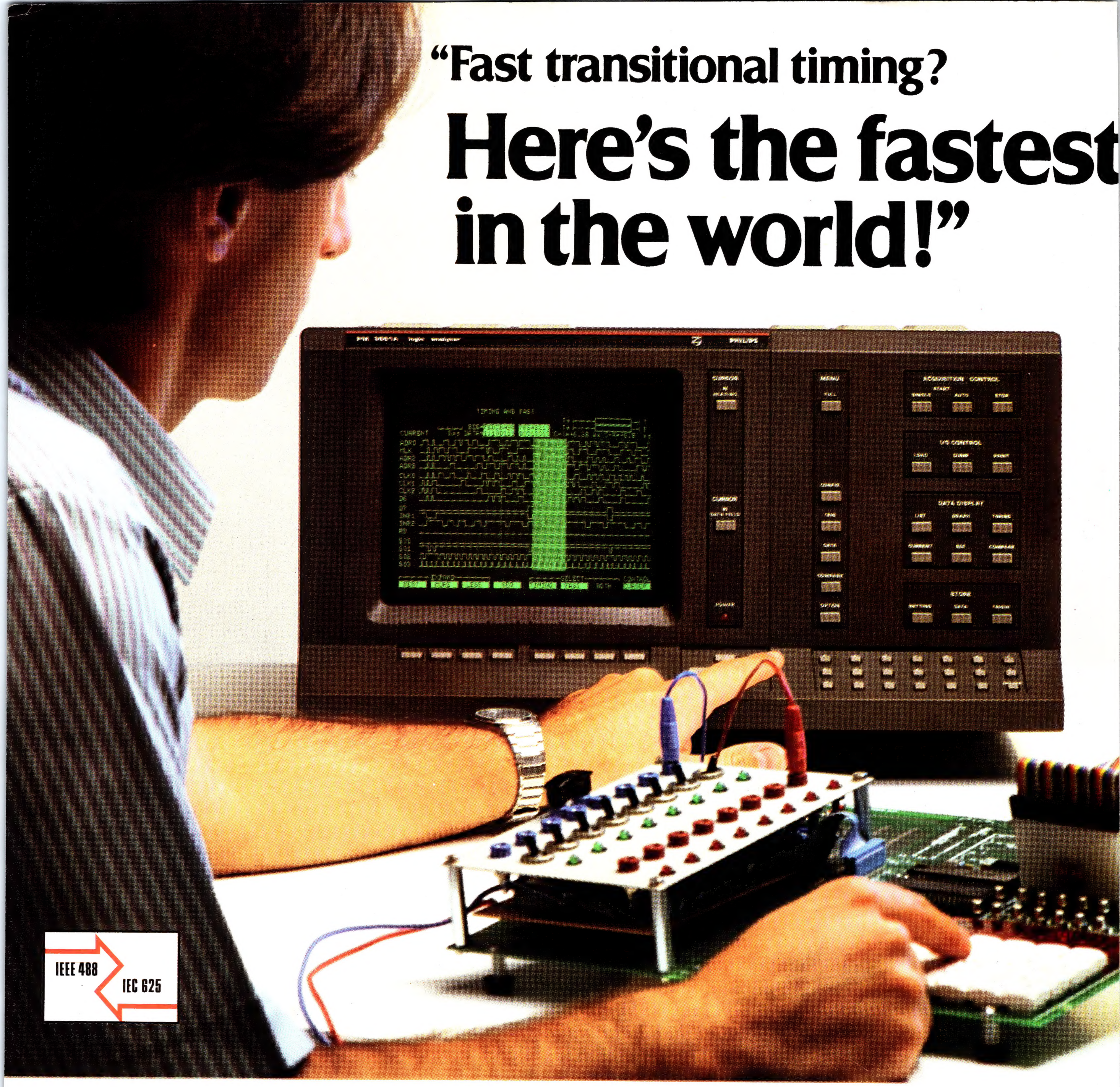
Koreans aim for a fast replay of the Japanese VCR story/28

Fiber-optic technology is on a roll/45

"Fast transitional timing?
Here's the fastest in the world!"



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- EMI/RFI noise immunity
- reduced cable size and weight for easier installation

Now, make certain you get exactly what you bargain for when you design your next optical fiber system...no more or less.

Belden can protect your performance. Many system designers assume the job is over once the bandwidth and attenuation requirements are determined.

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International edition

PREVIEWS

Next ElectronicsWeek

Spring means it's time for Electro again

The Northeast's change into its spring dress—budding trees, greening grass, and blooming tulips—is a harbinger of the annual Electro show. Alternating annually between New York and Boston, this year's show will take place in New York, the center of a tristate area that is undergoing a high-tech research rebirth. Long noted for the quality of its research centers, the New York-New Jersey-Connecticut region is once again on a roll: the U.S. has selected it as the home of one of its new supercomputer research efforts. Get the details in the next *ElectronicsWeek.*

SID focuses on new display technologies

At the annual conference and expo of the Society for Information Display, which will be held April 30-May 2 in Orlando, Fla., one of the highlights will be a close look at potential commercial applications for the latest in display technology. Displays are getting larger, brighter, and sharper even as their power demands recede. Those attending the meeting will choose from 89 technical papers on display systems, device characterization and fabrication, and voice-entry schemes. In addition, four sessions will focus on printing technology. A full preview will appear in next week's *ElectronicsWeek.*

Looking ahead in ElectronicsWeek

The Asian bid for high-tech parity

The electronics communities of the U.S. and Europe often view their Asian competition as Japan and the other guys. But nothing could be further from the truth: the high-tech aspirations of Japan, South Korea, Singapore, Malaysia, Indonesia, Hong Kong, and Taiwan often take quite different courses. An inside look is coming up in *ElectronicsWeek.*

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$\mathcal{F}(f)=g(f) * \mathcal{H}(f)$
2τ
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2 120 000 000 MHz
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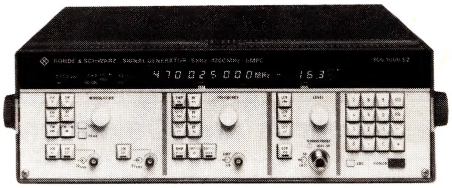
Best in its class from 5 kHz to 2.72 GHz

SMPD receives top marks whatever the test, e.g. in CEPT-based measurements on transceivers where it functions as an interference source up to 2.72 GHz, in the development of telemetry and telecommunication systems and in all sorts of general lab applications. Optional high-speed pulse modulation also means the testing of radar receivers under real conditions.

- Frequency range 5 kHz to 2.72 GHz
- Output level −143 to 13 dBm
- Highly linear φM and FM with wide deviations (e.g. max. deviation of 3.2 MHz at carrier frequencies ≥ 1.36 GHz) and precise AM over its entire frequency range
- Pulse modulation with rise and fall times of less than 10 ns and an on/off ratio of 80 dB, also simultaneously with AM and φM/FM
- IEC 625-1 and IEEE 488 remote control
- Spectrally pure signals for measurements on oscillators and out-of-band measurements on transceivers
- Reliable attenuator for system applications with more than 10 million guaranteed operations

The SMPC Signal Generator is the "little brother" of the SMPD with the same specifications up to 1.36 GHz.



Ask for the detailed data sheets **SMPD** and **SMPC**

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ElectronicsWeek

THE VOICE OF THE INDUSTRY, HEARD EVERY MONDAY

FIBER MAKES ITS MOVE

Lower costs edge coaxial and microwave/45

Technology Around the World

Microprocessors Intel takes the wraps off the 386. The semiconductor giant aims to catch up with front-runner Motorola in the 32-bit market. First samples of Intel's new microprocessor series will ship in six months **18**

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Speech Synthesis Sophisticated Italian VLSI chip has the right accent **20**

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Consumer Electronics South Korea tries for a VCR replay. Latecomer Korean firms plan to grab a piece of the still-growing market for video cassette recorders with lower prices and higher quality **22**

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Communications Broad use seen for narrowband technology. Squeezing everyone into the 800-to-950-MHz spectrum requires some fancy footwork. The solution could be to squeeze more channels out of existing bands **28**

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WOW!

Dual Channel Power Measurements to ~~50~~ GHz AND −50dBm!

Boonton has combined with Hughes Aircraft to extend the sensitivity and convenience of the Boonton 4200 dual-channel power meter to the accurate measurement of millimeter-wave signals. Three new waveguide sensors, each with 60 dB dynamic range, operate in K-band (18 to 26.5 GHz), Ka (26.5 to 40 GHz), and Q (33 to 50 GHz). Based on Hughes' "whisker-contacted", SEM-assembled, millimeter-wave diode technology, these sensors feature a maximum SWR of less than 1.3 for low measurement uncertainty. Computer-generated cal factors are provided in 1 GHz steps. Nine coaxial sensors are also available with a choice of 50Ω or 75Ω inputs, high sensitivity diode or true RMS thermocouple detection, and with a dynamic range of up to 70 dB to cover levels from −60 dBm to +30 dBm, 100 kHz to 18 GHz.

The 4200 can store complete calibration data for up to 8 sensors in nonvolatile RAM for quick interchangeability.

Stored cal factors are accessible for automatic interpolated measurement corrections as a function of frequency. Fast settling times and a user-defined "raw data mode" speed measurement times with GPIB. Features of the 4200 include display in dB or watts, single or independent dual channel operation, instantaneous display of the difference of two channels, selectable dB limits, dc output, and self-calibration to an internal NBS — traceable reference.

Check out the measurably better Boonton 4200 with your local representative, or contact us directly for full information.

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Circle 5 on reader service card

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Communications Technology Fiber optics takes over. Lower costs for setup and maintenance as well as space-saving installation give optical-fiber systems an edge over systems based on coaxial and microwave technologies. The key is the elimination of expensive repeaters in high-capacity links **45**

Manufacturing Off-the-shelf modules cut ATE costs. Flexible automated test equipment not only beats dedicated systems for low-volume production, field service, and production rework—it also brings down testing costs **49**

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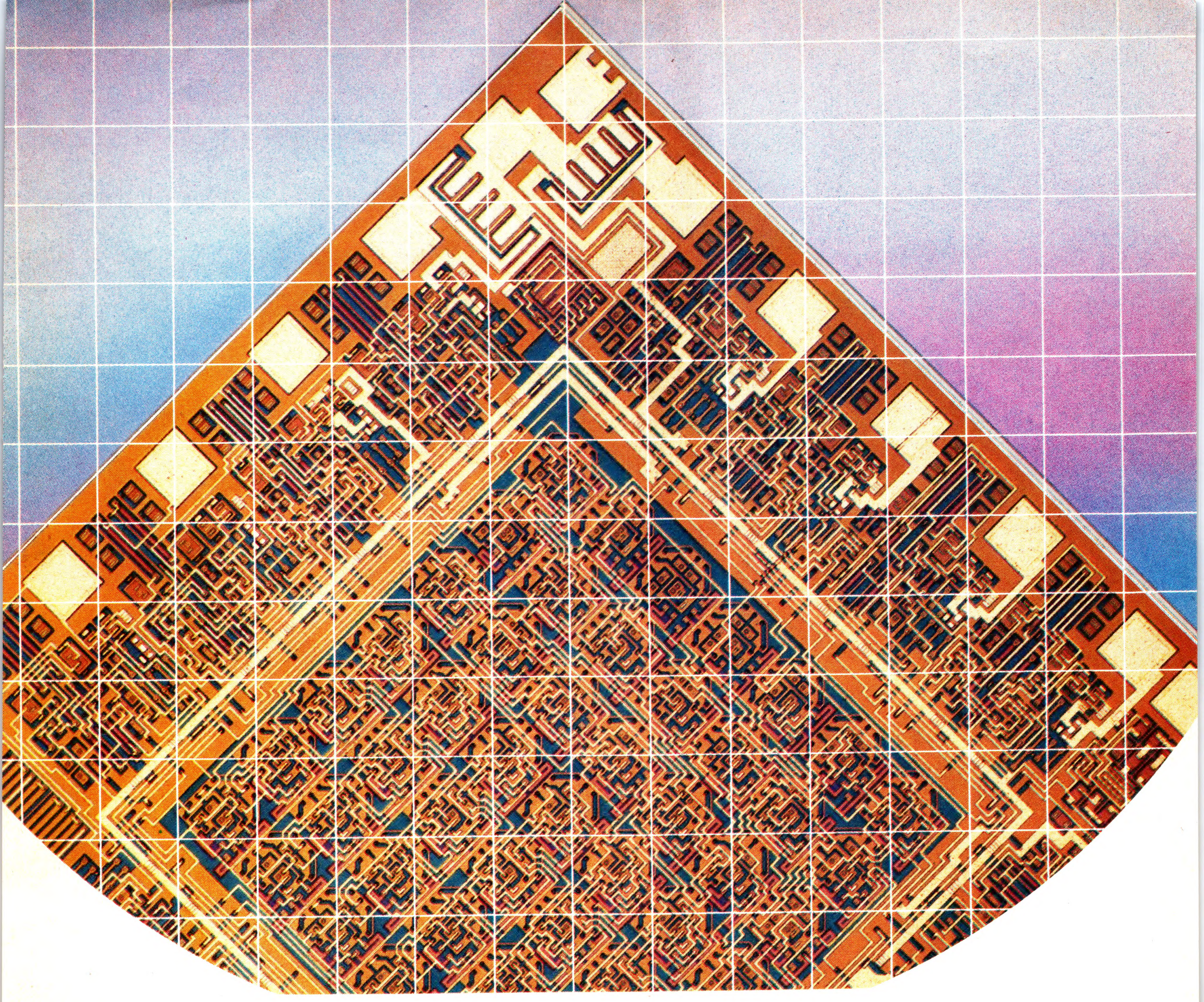

ULA*. Gives you the edge for custom LSI.

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You should be, to gain the edge over your competition.

To get the full benefits of custom LSI you must include not just the system logic but also the I/O and analogue functions.

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Spectra-Physics

European Headquarters
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☐ the new 10 mW laser

please send to: Spectra-Physics
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CIRCUIT SAFETY

In todays scenario of innovation in technology, circuit safety if ignored, can be costly. Fail-safe devices, responding to control criteria are not only necessary, they're essential.

To aid your industrial automation functions with the maximum of reliability, Thomson Semiconductors has designed a range of Auto-Protected Controls.

Designed to conform with international standards, these components form a direct interface between TTL-CMOS logic-based and microprocessor-based control systems and the power aspect of your application: lamps, relays, electro-valves, etc...

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A NEW HORIZON

AUTO-PROTECTED CONTROLS

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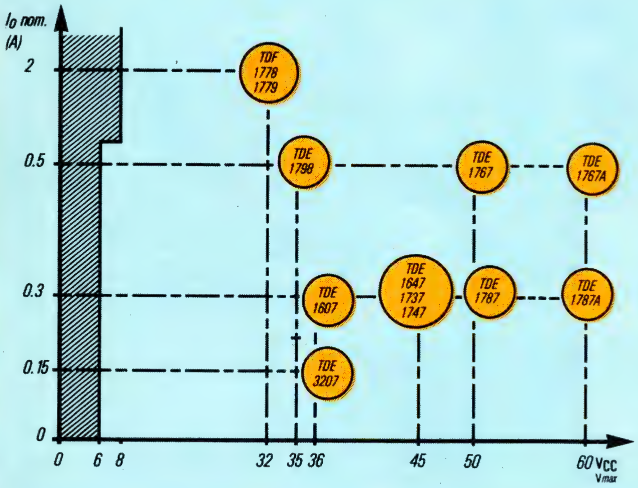
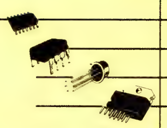


		TDE 1607	TDE 1647	TDE 1737	TDE 1747	TDE 1767	TDE 1767A	TDE 1787	TDE 1787A	TDE 1798	TDE 3207	TDF 1778	TDF 1779
CASE		*		*	*								
		*	*	*	*	*	*	*	*	*	*		
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CIRCUIT	Single	*	*	*	*	*	*	*	*	*	*		
	Dual											*	*
LOAD ,	Grounded	*	*		*	*	*	*	*	*	*	*	*
	VCC			*									
SHORT CIRCUIT CURRENT	Internally limited									*		*	*
	Programmable by external resistance	*	*	*	*	*	*	*	*		*		
RESET	Automatic	*	*	*	*						*		
	With input					*	*	*	*	*		*	*
ALARM OUTPUT						*	*	*	*	*		*	*
GROUND CUT OFF PROTECTION					*	*	*	*	*	*		*	*
INTEGRATED RAPID DEMAGNETISING ZENER DIODE												*	

TDE 1767 A

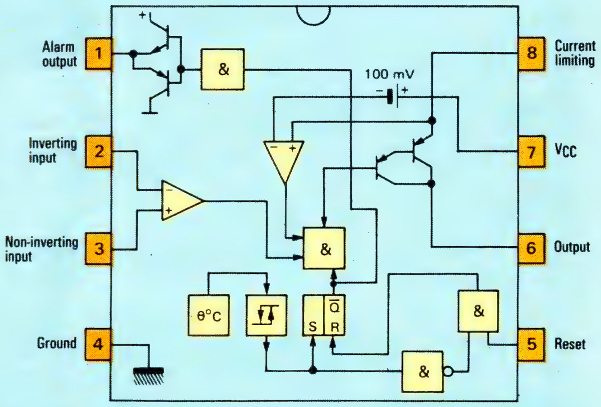
It is a monolithic amplifier designed for both high current and high voltage applications, specifically to drive lamps, relays, stepper motors, etc. This device is essentially blow-out proof with its output short-circuit protected. In addition thermal shut-down is provided to keep the IC from over heating.

The TDE 1767 A operates over a wide range of supply voltages from standard ± 15 V op-amp supplies to voltages + 6 V to + 60 V used for industrial electronic systems.

Features include

- *Plug-in case, DIP 8-Pin standard configuration.*
- *Thermal resistance junction-ambient: $R_{th\,(j\text{-}a)} = 80°\,C/W$.*
- *Supply voltage range: 6 to 60 V*
- *Available current at output: $I_0 = 500\,mA$ at $T_a = 85°\,C$.*
- *Reset: active when up (logic threshold = 1.4 V).*
- *Alarm output: for LED control.*

BLOCK DIAGRAM - TDE 1767A



TDF 1778/79

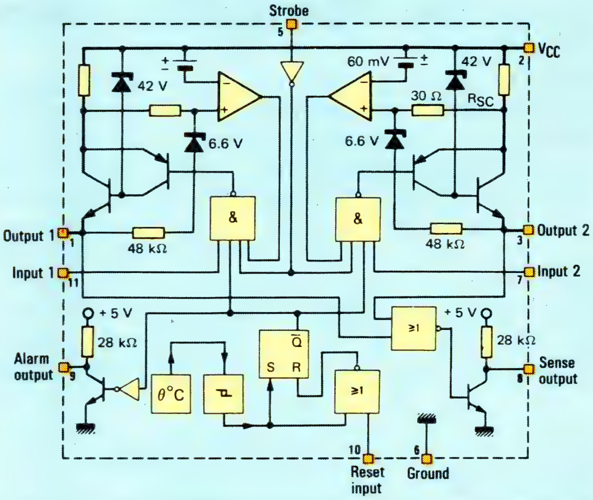
They are dual source drivers delivering high current with the capability of driving high inductive loads (electro-valves, contactors, relays, etc.).

These devices are also blow-out proof with each output protected against short-circuits. If internal dissipation becomes too high the drivers will shut down to prevent excessive heating.

Features include

- *Dual control circuit.*
- *Thermal resistance junction-ambient: $R_{th\,(j\text{-}a)} = 40°\,C/W$.*
- *Supply voltage range: 8 to 32 V (60 V max for 10 ms).*
- *Available current at output: $I_0 = 2 \times 2A$ (Parallel installation possible).*
- *The TDF 1778 comes fitted with a rapid-demagnetising Zener diode: 42 V.*

BLOCK DIAGRAM - TDF 1778



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Meetings

NTT International Symposium '85, Nippon Telegraph & Telephone Public Corp. (Yuko Ishida, NTT, 200 Park Ave., New York, N.Y. 10166), Keidanren Hall, Tokyo, May 20-21.

35th Electronic Components Conference, IEEE and EIA (J.A. Woolley, 3M Co., 3M Center, Building 207-1W-10, St. Paul, Minn. 55144), Capital Hilton Hotel, Washington, May 20-22.

Custom Integrated Circuits Conference, IEEE (Aris Silzars, Tektronix Inc., P.O. Box 500 MS 13-800, Beaverton, Ore. 97077), Portland Hilton, Portland, Ore., May 20-22.

Commercial Artificial Intelligence: Myths & Realities, Gartner Group Inc. (Lynn M. Bentley, Gartner Group, P.O. Box 10212, Stamford, Conn. 06904), Century Plaza Hotel, Los Angeles, May 20-22.

Naecon '85—National Aerospace & Electronics Conference, IEEE (Patricia V. Weaver, Naecon, 110 E. Monument Ave., Dayton, Ohio 45402), Dayton Convention Center, Dayton, May 20-24.

USTA/USTSA Western Telecommunications Showcase '85, U.S. Telephone Association and U.S. Telecommunications Suppliers Association (USTSA, 333 N. Michigan Ave., Suite 161B, Chicago, Ill. 60601), Las Vegas Convention Center, Las Vegas, May 20-23.

Semicon/West '85, Semiconductor Equipment and Materials Institute (625 Ellis St., Mountain View, Calif. 94043), San Mateo Fairgrounds and Bay Meadows Race Course, San Mateo, Calif., May 21-23.

Control Expo '85, *Control Engineering* (Tower Conference Management Co., 331 W. Wesley St., Wheaton, Ill. 60187), O'Hare Exposition Center, Rosemont, Ill., May 21-23.

OPTO '85—Fifth Optoelectronic Technology Conference, ESI Publications (12 Rue de Seine, 75006 Paris, France), Palais des Congrès, Paris, May 21-23.

1985 Trends and Applications Conference Utilizing Computer Graphics, IEEE *et al.* (Joseph Collica, A245 Technology Building, National Bureau of Standards, Gaithersburg, Md. 20899), Sheraton N.W. Washington Hotel, Silver Spring, Md., May 21-22.

Power '85—Power Supply & Conversion Conference and Exhibition, British Power Supply Manufacturers Association (Jim Hay, Tower Conference Management Co., 331 W. Wesley St., Wheaton, Ill. 60187), Brighton Metropole Exhibition Centre, Brighton, England, May 21-23.

Cleo '85, Conference on Lasers and Electro-Optics, IEEE and Optical Society of America (Optical Society of America, 1816 Jefferson Pl., N.W., Washington, D.C. 20036), Baltimore Convention Center, Baltimore, May 21-24.

Seminars

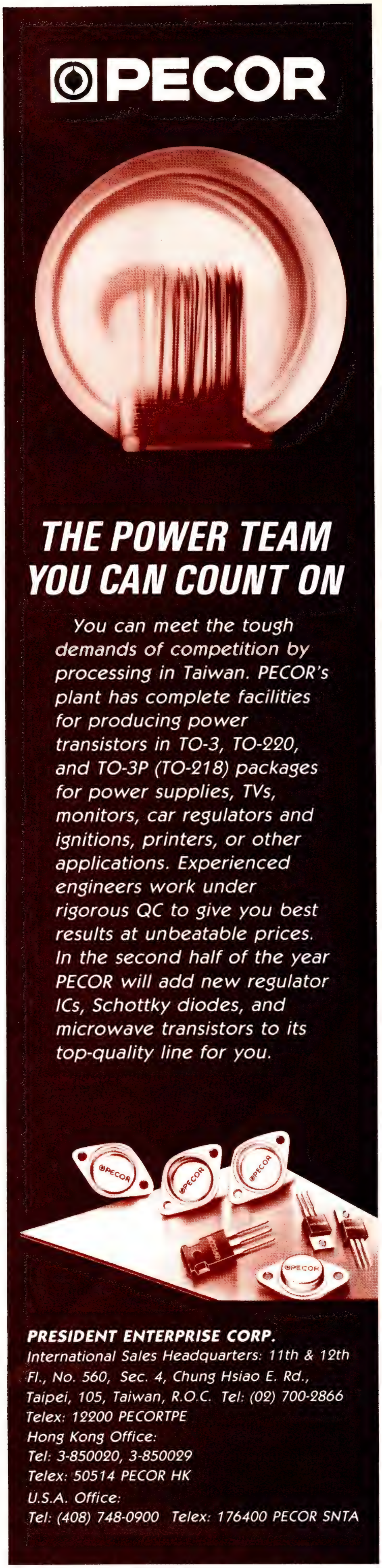
Expert Systems II, Technology Transfer Society (Technology Training Corp., Department EXS II, P.O. Box 3608, Torrance, Calif. 90510-3608), Hilton at Colonial, Boston, May 16-17.

Comgraf/Design '85, Pratt Center for Computer Graphics in Design (9 Skyline Dr., Department R, Hawthorne, N.Y. 10532), Grand Hyatt, New York, May 18-19.

Data Network Design and Performance, Datapro Research Corp. (1805 Underwood Blvd., Delran, N.J. 08075), Washington Conference Center, Washington, May 20-22.

Network Communication Protocols, Center for Advanced Professional Education (CAPE, 1820 E. Garry St., Suite 110, Santa Ana, Calif. 92705), Colony Square Hotel, Atlanta, May 20-22.

11th Environmental Test Equipment Service Seminar, Thermotron Industries Inc. (291 Kollen Park Dr., Holland, Mich. 49423), Hope College, Holland, Mich., May 20-23.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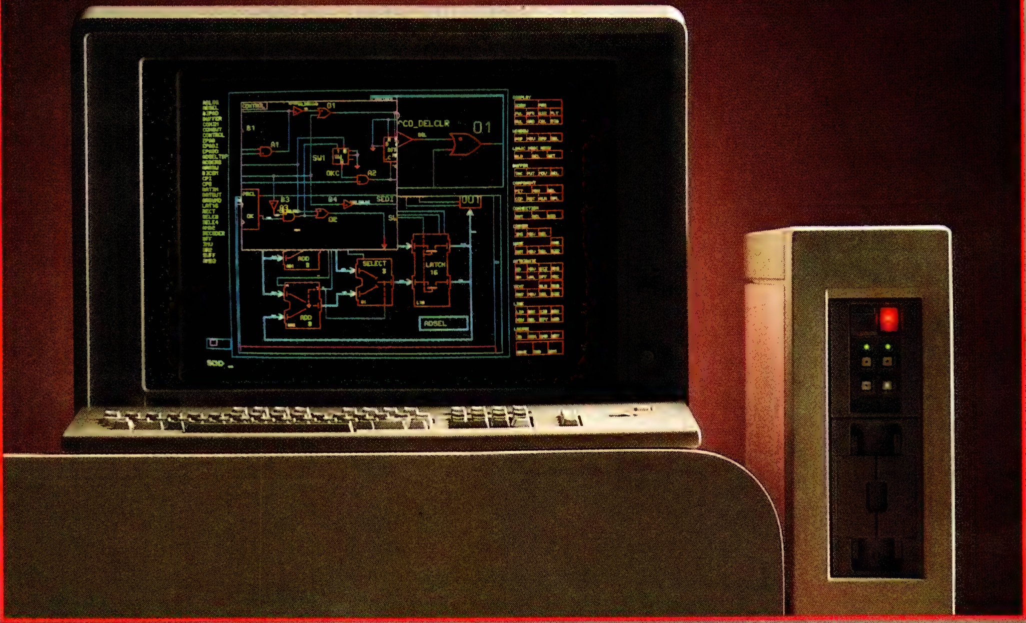

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UP FRONT

Hughes satellite joint venture in Japan gets OK to seek license

One of the first U.S. firms to benefit from any move by Japan toward opening its trade doors could be Hughes Aircraft Co., which last week got permission to apply for a license to jointly operate a domestic communications satellite system in that nation. Hughes's joint venture company, Japan Communications Satellite Co., was formed last September; its partners are C. Itoh & Co., which owns 40%, and Mitsui & Co., holding 30%. If the venture's license application to Japan's Ministry of Posts and Telecommunications gets the go-ahead, as Hughes expects, the way would be cleared for developing a two-satellite network to cost between $300 million and $400 million. The proposed satellite system consists of two Ku-band satellites, frequencies made available for the first time in Japan for this purpose. Each satellite will have 32 transponders, with capability to transmit 32 channels of TV programming, or a mix of TV, voice, and data transmission. The intention is for transmission to be received by small, low-cost antennas, Hughes says. Plans call for the satellites to be launched in early 1988 by a U.S. space shuttle. ☐

Computervision to slash work force by nearly 1,000

Computervision Corp. last week said it would lay off nearly 1,000 workers. The layoffs are by far the largest in a recent series announced by Massachusetts-area high-tech companies. A company representative said the layoffs were necessary to bring operating expenses in line with projected revenues. Earlier this month, Computervision said it expected a loss for this year's first quarter of as much as $15.7 million. Computervision blamed the slowdown on the high value of the dollar overseas, a slowing of capital expenditures, and "a period of product transition . . . that began 18 months ago and won't be completed until 1986." The representative described the transition as "moving from host-based systems to state-of-the-art work stations with open network architecture." Alice Greene, a consultant at Arthur D. Little Inc., projects the computer-aided-design and -manufacturing market's overall growth will exceed 30% this year, with certain segments growing even faster. And although older firms in the business are confronted with the need to integrate CAD/CAM with other systems and offer work stations, Greene says the traditional CAD/CAM segment "still has a lot of potential. It's not saturated by any means." ☐

Britain eyes new satellite technology

Britain's Marconi Defence Systems Ltd., in Stanmore, Middlesex, plans to develop a prototype satellite transponder to tap the as-yet-unused 20-to-30-GHz band. At these higher frequencies, data rates up to 500 Mb/s can theoretically be supported. Also, terminal equipment is smaller than today's gear. Britain's Department of Trade and Industry is funding the $244,000 project as a part of a program to sharpen the country's technology in civil satellite communications. This market is set for rapid growth, according to a recent report by the Battelle Institute, which predicts a 300% to 400% increase in the number of transponders in orbit by 1998 and a steady 15% annual increase in satellite-relayed traffic up to the end of the century. The contract was awarded by the Royal Signals and Radar Establishment. Aside from developing a modular transponder, Marconi will evaluate the potential for future enhancements such as the addition of on-board processing hardware and multibeam payloads. This technology could be used to provide inter-satellite and space station links as well as data relay services. Meanwhile, the European Space Agency's Olympus multirole satellite, due for launch in July 1987, will have as one of its four transponder payloads a 20-to-30-GHz transponder with two steerable small spot beams from Rome's Selenia SpA. ☐

UP FRONT

Tandem brings out low-end processor

Tandem Computers Inc. has moved its on-line transaction processors out of the computer room and into the office—and, it hopes, into the low-end market—with its new Nonstop EXT system. Unveiled last week by the Cupertino, Calif., firm, the EXT packs all system hardware, including disk storage, into a single cabinet that can fit through a door. An operating system, software for data-base management and networking, and a Tandem 6530 terminal is included in the two-processor 4-megabyte base system, which sells for $120,000. An expansion cabinet with an extra two processors and an additional 4 megabytes of main memory sells for $100,000. ☐

Japanese telecom exports to the U.S. jump 73%, imports slip 3% in 1984

Just when the issue of telecommunications equipment is at the center of U.S.-Japan trade friction comes the news that Japanese telecommunications-product exports to the U.S. last year grew 73.2%, to $1.31 billion. Meanwhile, imports from the U.S. dropped 3.7%, to $112 million, said the Communications Industries Association of Japan. Japanese telecommunications exports worldwide rose 30.4%, to $2.3 billion, while imports slipped 1.7%, to $135 million. ☐

IBM sells Rolm's Mil-Spec division to Loral

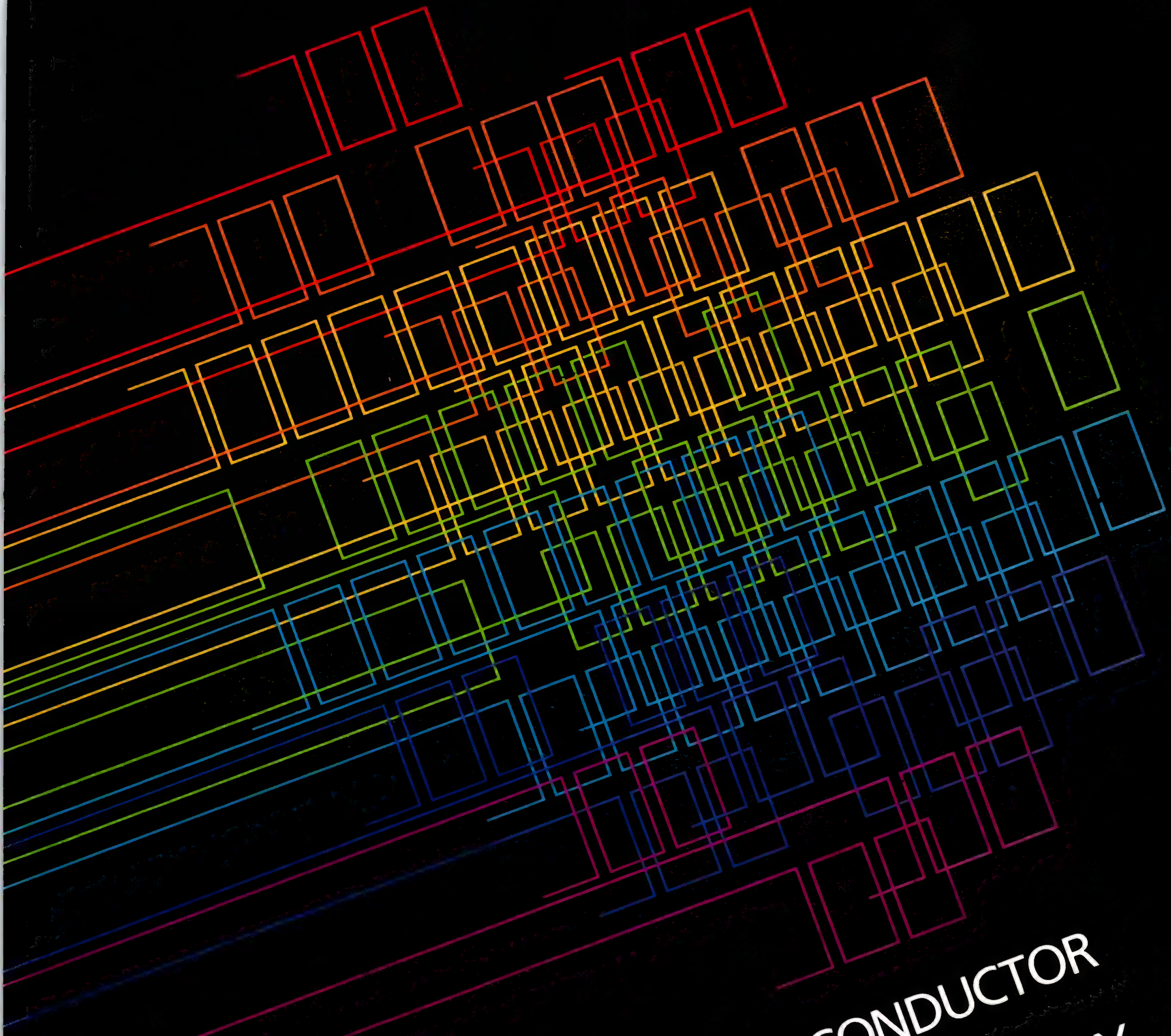
Complying with an order from the U.S. Justice Department that was designed to limit its sales of computers to the government, IBM Corp. agreed last week to sell the military computer operations of its Rolm Corp. division to Loral Corp., New York, for $100 million. The Justice Department determined that the Rolm division duplicated IBM's Federal Systems Division, which sells computers to the government. IBM had agreed to sell the division to complete its acquisition of telecommunications-equipment vendor Rolm. Loral, a designer and manufacturer of electronic-warfare and radar systems, recorded $500 million in sales last year, of which 90% was in military electronics. Loral says it will operate the division as a separate subsidiary. ☐

European market for LANs enters period of explosive growth

The Western European market for local-area networks has entered a period of explosive growth, having expanded at a rate of 156% per annum for the last two years, says market researcher IDC Europa Ltd., London. Shipments of LAN systems to Western Europe totaled 2,980 in 1982, 9,360 in 1983, and 19,618 in 1984, according to the firm's latest Eurocast report. The study notes that lack of software has retarded growth, but this situation is expected to change when IBM Corp. enters the market. The ready availability of software, together with the falling price of LAN chips, will increase the market's momentum, and by 1990 shipments will be running at 345,000 installations per year. ☐

10,000-word synthesizer set for debut at speech meeting

New York's World Trade Center may become the twin towers of babble when dozens of speakers talk about talking at next week's Speech Tech '85. More than 1,000 attendees are expected to listen to presentations on voice synthesis in consumer, automotive, aerospace, and office-automation applications. Raymond Kurzweil, of Kurzweil Applied Intelligence Inc., is expected to reveal details of a speech synthesizer with a 10,000-word vocabulary. In addition, GTE Government Systems Division plans to detail a voice terminal that digitizes, analyzes, and synthesizes voice. ☐



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SCIENCE/SCOPE

After slowing from 107,000 miles per hour to subsonic speeds in just two minutes, NASA's Project Galileo Probe will take the first direct samplings of Jupiter's atmosphere later this decade. During its plunge through the brightly colored clouds, much of the Hughes Aircraft Company probe's forward heat shield will be eroded by temperatures of several thousand degrees. Once the probe has slowed, a mortar in the rear heat shield will fire to deploy a parachute. This parachute will pull off the back cover, releasing in turn the main parachute. Small explosives will release the front heat shield from the descent module. The parachute will slow the descent as the shield continues into the interior of the planet. Data will be transmitted to an orbiting spacecraft for relay to Earth. Project Galileo is set for launch in May 1986 and is scheduled to arrive in August 1988.

An antenna system made entirely of composite materials is operating on LEASAT, a communications satellite launched last year from the space shuttle. The antenna's structural elements and fittings are made of carbon powder, fiber, and epoxy. This approach eliminates metal pieces that cause spurious signals when impinged by many different high-energy radio signals. The carbon powder also improves the conductivity of the outer surface of the antenna and prevents arcing, the harmful build-up and discharge of static electricity. Hughes built the 7.5-ton LEASAT for operation by a subsidiary, Hughes Communications Services, Inc. The Navy leases capacity for all U.S. military services.

A new 5-volt-only, 256-bit nonvolatile random access memory combines the data retention capabilities of an EEPROM with the convenience of a CMOS RAM. The Hughes circuit, designated H13500, is designed for such applications as reconfigurable systems and fault protection without battery back-up. It is organized as 64x4 bits. Both the read and write operations are performed as in a standard CMOS RAM. A single store operation transfers all data in the RAM cells in parallel to the background EEPROM array. The recall operation restores data in parallel to foreground RAM cells.

A new laser that better penetrates battlefield smoke, haze, and dust will let tank gunners determine the range of any target they can see with a thermal imaging system. The laser is the first carbon dioxide laser rangefinder developed in the U.S. for tactical military applications. It determines range based on the few millionths of a second it takes a laser pulse to reach a target and reflect back. During advanced development tests, the rangefinder demonstrated greater performance under obscured battlefield conditions than the solid-state lasers currently used for military rangefinding. Because the laser and the thermal imaging system operate in the same wavelength, they have the same performance characteristics under battlefield conditions and bad weather. The Hughes laser is also harmless to the human eye and can be safely fired during training exercises. A development model has been configured for evaluation in the M1 Abrams main battle tank.

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THURSDAY *April 4*

IBM Corp. announced that scientists at its Thomas J. Watson Research Center have developed **the first fully scaled 0.5-micron process memory and logic chips.** IBM says the chips, which achieve a density 10 times that of current technology, are an important step in developing semiconductors with more than 100,000 logic elements or the capacity to store 16 million bits of data. The memory chip's cells are the smallest ever made, say the researchers, measuring just 8.5 square microns, or 13 billionths of an inch square. Commercial products of this type are not likely to surface until near the end of the decade.

FRIDAY *April 5*

ITT Corp. cut prices on its XTRA line of personal computers by up to 39%. Today's action comes just a week after similar price cuts by IBM Corp. on its Personal Computer line. Pricing on the XTRA Model II fell from $1,895 to $1,595; the Model III fell from $4,395 to $2,595; and the Model IV dropped by a full $2,000 to $3,095.

MONDAY *April 8*

Mosaic Systems Inc. has developed a process to **replace conventional printed-circuit boards by bonding computer chips directly to a 4-in. wafer,** the company announced today. The wafer contains a gridwork of vapor-deposited wires, separated by a thin insulating layer of amorphous silicon. When an electrical pulse is applied, the silicon becomes conductive and creates links across which signals can travel. Floating Point Systems Inc. is working with Mosaic to develop ways to incorporate the technology into the company's product line. . . .**Lotus Development Corp. signed a letter of intent to purchase Software Arts,** developer of Visicalc, the computer spreadsheet program that was a market leader until 1983, when it was surpassed by Lotus 1-2-3. Terms of the deal were not announced, but Lotus says Software Arts' founders, Daniel S. Bricklin and Robert Frankston, have signed letters of intent to join Lotus's development teams.

TUESDAY *April 9*

Japan has put together a comprehensive trade plan to ease the tensions brought on by a widening trade gap with the U.S., which reached $37 billion in 1984. For starters, Japanese Prime Minister Yasuhiro Nakasone advised his people in a TV address today to "buy more foreign goods" or risk "a serious depression." **"If each Japanese buys $100 in foreign goods, the increase in imports" would please foreign exporters, he said.** The plan also includes the simplification of licensing procedures for telecommunications equipment, copyright protection for computer software, and the possible elimination of tariffs on electronic goods.

WEDNESDAY *April 10*

The lagging computer market claimed more casualties today when **Honeywell Inc. said it will lay off 120 salaried workers and furlough 4,100 others** for four nonconsecutive weeks over the course of the year. Almost all of the layoffs will affect employees of the company's Massachusetts-based small-computer and office-systems group, which builds microcomputers and the DPS line of minicomputers . . . .Taking a more aggressive view of the market, **Sperry Corp. said it plans to build a personal computer factory in Brisbane, Australia.** It will be operational in early 1986. ☐

AROUND THE WORLD

INTEL TAKES WRAPS OFF 386

Semiconductor giant goes after the market for 32-bit machines with a new series of microprocessors

☐ *by Larry Waller*

Anaheim, Calif.

Traditionally, Intel Corp. has been the front-runner in the microprocessor business, launching the market in 1971 with a 4-bit chip and then setting the early pace in 8- and 16-bit machines. But now the market is edging toward the 32-bit era, and Intel finds itself running behind Motorola Inc. and National Semiconductor Corp., both of which have 32-bit chips in production.

Intel had kept its 32-bit plans close to the vest. But last week, it kicked off a series of 33 nationwide briefings here on its full 86 microprocessor family. With that, it took some of the wraps off its 32-bit entry, the iAPX 386. The chip, however, has yet to be formally introduced, and Intel won't ship samples for at least six months.

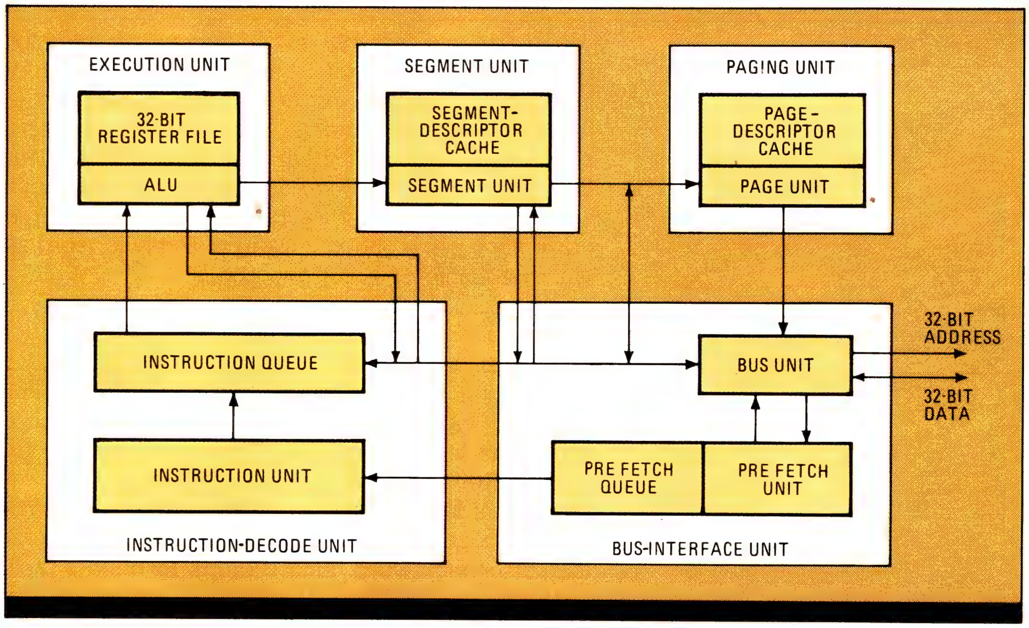
The purpose of the round of briefings is "to give you designers a peek at the 386 and allow you to plan where it fits into the 32-bit market," said Matthew A. Katzer, of Intel's corporate strategies staff.

Meanwhile, semiconductor-industry observers think Intel is trying to check the momentum that Motorola is building with its 68020 chip, formally introduced last June. Putting numbers on the market at stake in 16- and 32-bit microprocessors over the long run is difficult. But at least one market research firm, Dataquest Inc., last year pegged it roughly at just under $1.5 billion for 1989.

Good timing. "Intel has made a very smart move," says design and process consultant Will Strauss, of Forward Concepts Inc. The timing is especially important: Motorola customers are evaluating the 68020 before buying in quantity. "If this [Intel's briefings] staves off only a few people from committing to the 68020, that could mean tens of thousands of chips some years out."

Motorola already has an impressive list of design-ins to report. The firm's executives maintain they had 100 systems in their pocket when they introduced the chip, partly because of a worldwide beta sampling program. The number has since grown to 500 systems.

Part of Motorola's success, presumably, stems from the fact that systems designed around the 16-bit 68000 and 68010 chips can be upgraded fairly easily to the 68020. Intel has the same sort of upward migration to sell to its customers. The keynote of Intel's presentation is that the new processor's continuity with the 16-bit 286 will be an advantage because it does not make investments



Take five. Intel's 32-bit iAPX 386 microprocessor architecture is based on a quintet of building blocks that includes on-chip memory management. The bus-interface unit controls communications among blocks.

in operating software and support tools obsolete.

"We want to make sure the 286 user understands the progression into the 386," adds George Alexy, marketing manager for high-performance microprocessors.

Without divulging all details about the 386 during the briefings (staged by Intel's component distributors, with Hamilton-Avnet doing the first ones), Intel officials outlined enough of its overall performance for designers to compare it with other 32-bit microprocessors. Besides the 386 processor, to be available in both 12- and 16-MHz versions, the set includes the 32-MHz 82384 clock generator and the 80287 floating-point coprocessor chip. (The 386 also will run with the 80287 coprocessor intended for the 16-bit 286).

The 386 incorporates about 300,000 transistors, compared with the 286's 140,000. As for central-processor performance, Intel will not cite a figure in millions of instructions per second, saying only that it is two to three times faster than the 286, depending on the application. Motorola, on the other hand, reports that its 16.67-MHz 68020, slated for sampling in May, can achieve a steady run rate of 2.5 mips. For arithmetic instructions, the 386 proprietary hardware speeds up numerics; a 32-by-32 integer multiply, for example, takes only 0.6 to 2 μs.

On-chip management. As for architectural features, memory management is incorporated on chip, compared to the off-chip scheme adopted by Motorola. Intel insists that this speeds system operation by cutting the delays inherent in using external components. Motorola maintains that an off-chip memory-management unit means designers can choose what they really want.

Intel's memory management includes both protection and paging hardware, benefits previously unavailable on chip. In paging for cache memory, for example, the key "hit rate" on page references is specified at 98%, much higher than other processors, says Intel. This is important in designing a cache memory system, says consultant Strauss.

Intel says the memory size is virtually unlimited; it has 4 gigabytes of physical memory and 64 terabytes of virtual memory. (As an illustration, 1 terabyte of memory would provide 15 bytes for each person on earth.)

The development of the 32-bit market from here on is a subject about which the players differ, observes Intel's Alexy. "We think it will evolve slowly, since it is another step up in sophistication."

Now or then? In fact, his firm believes that products using 32-bit processing will move up from the 16-bit level, where Intel's strength is a huge base of application software. Other companies intend to establish a beachhead at 32 bits, which seems to many a tougher proposition. Motorola, in contrast, is convinced that the 32-bit market is already here, with technical work stations likely to be the large initial consumer.

Plenty of competition is in the offing—Intel counts 18 players already committed or in the wings. The effect of 32-bit products on the market is at least three years away, perhaps as far away as the next decade, many believe. Intel has dropped its first try at the 32-bit league, the iAPX 432 unveiled in 1981, which is not compatible with the rest of its family.

National Semiconductor was the second firm into the 32-bit market with its 32032 chip. The chip has been on the market for some months, and the firm now claims to be shipping small production quantities of the 6-MHz version and ramping up on the 10-MHz unit. Full production is slated for May. The second source on the 32032, Texas Instruments Inc., expects to have samples in the second half of this year.

Motorola as yet has not signed a second-source agreement but reports that it has talks underway with its 68000 partners. ☐

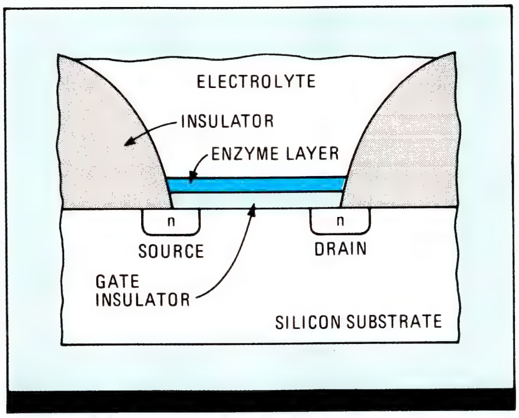
Additional reporting was supplied by J. Robert Lineback, in Dallas, and Clifford Barney, in Palo Alto.

BIOTECHNOLOGY

HYBRID SENSORS USE ORGANIC MATERIALS

Munich

Bioelectronics is more often a subject for scientific speculation than for serious research and development. But one aspect, biosensors, has already triggered R&D here in Bavaria's capital. A 12-person research team at the Technical University has developed biosensors that integrate a biochemically active substance with semiconductor electronics on a 32-mm^2 silicon substrate.



Well immersed. The enzyme layer reacts with the electrolytic solution in proportion to the concentration of the test substance. An insulator keeps the FET dry.

Led by Franz Riedlberger, Peter Berg, and Toni Näbauer of the school's Department for Integrated Circuits, the team is experimenting with techniques for detecting the concentration of penicillin in pharmaceutical-production processes. It will have the first practical units ready for demonstration in the third quarter of this year; they should be on the market in a year or two.

Although no firm definition for a biosensor yet exists, by consensus it is a mixed-technology device consisting of a biochemically or biologically active component and an electronic transducer. The bio component may be an enzyme or a microbe; the transducer may be a FET, a thermistor, or an electrode. The biosensor generally serves to determine the concentration of a biochemical material in a chemical solution—a job that usually calls for a spectrometer or spectrophotometer.

Such equipment is not only voluminous and expensive but also needs an elaborate system to evaluate the measured results. In contrast, a biosensor is small, inexpensive, and delivers an easily processible output. Further, it takes about three minutes to evaluate biochemical reactions—a shorter time than is required to interpret photometric data.

An active solution. For operation, the biosensor is immersed in an electrolytic solution containing the biochemical material whose concentration is to be measured. Upon contact with the sensor's biochemically active component, a chemical reaction takes place.

In the Munich approach, a FET acts as the transducer and the enzyme penicillinase as the biochemically active substance. As the enzyme reacts with the solution, its concentration can be measured over time. Although this has long been a standard technique, using FETs for measurement is new.

Riedlberger points out that a FET makes an excellent transducer because the impedance conversion occurs directly at the point of measurement, thereby eliminating the noise that could result from capacitive or inductive coupling of stray fields into the sensor leads. FET-based biosensors also are small and can be assembled into an array on a chip, with each sensor detecting a different biological material. In addition, FETs are economical to make.

In its present configuration, the Munich biosensor builds upon an ion-sensitive FET without metallization. Only a 9-mm^2 area on the silicon substrate is active; its remaining area insulates the FET. When contact is initiated between the enzyme and the electrolyte, a chemical reaction takes place that changes the pH of the solution. The degree of change is translated into a voltage (59.2 mV for each whole pH value), which is sensed by the FET and converted to a drain current of around 100 μA.

International efforts. To be sure, the idea of electronic biosensors did not originate with the Munich group. In the U.S., for example, the University of Utah in Salt Lake City is a leader, and in Japan several teams are reportedly active in the field. But Riedlberger claims that his team was the first to make a biosensor that uses a custom FET. –**John Gosch**

SPEECH SYNTHESIS

ITALIAN VLSI CHIP HAS THE RIGHT ACCENT

Turin, Italy

Like most telecommunications research facilities, the Centro Studi e Laboratori Telecomunicazioni SpA (CSELT) of Italy's giant STET government telecommunications group is working intensively to develop a low-cost vocal system that can synthesize and recognize speech. And the CSELT has taken a major first step—integrating a speech synthesizer on a single very large-scale integrated circuit.

What distinguishes the CSELT's chip from one-chip synthesizers already on the market is the sophistication of its speech-production model—which makes for high-quality synthesized speech. In addition, it is based on an easy-to-test modular architecture.

Prototypes of the CSELT's 30,000-transistor chip have been produced in a 4-μm n-channel silicon-gate technology by STET confrere SGS-Ates Componenti Elettronici SpA. The chip can be used to build a complete speech synthesizer with only the addition of a standard microprocessor and a read-only memory to store necessary phonetic data.

The synthesis system that is integrated on the CSELT chip is based on a pitch-synchronous linear predictive coding scheme. This coding scheme produces a synthetic signal that is free of the discontinuities that cause speech quality to deteriorate. The system uses a digital lattice filter along with two excitation generators, one each for voiced and unvoiced sound, to synthesize both male and female speech.

CSELT's synthesis is based on a pitch-synchronous linear predictive coding, which avoids discontinuities that degrade speech quality

The chip's architecture is based on three buses—an 8-bit input/output bus, an 8- to 12-bit internal data bus, and a 14-bit filter-algorithm computation bus. This multibus structure lends itself to a modular configuration so that the chip operates under control of three interacting processors, each in turn controlled by an independent finite state machine.

Calculating. Key to the quality of the IC's synthesized speech is the CSELT's pitch-synchronous approach. Using this method, a duration and pitch is calculated for each segment of speech to be synthesized. When the duration for a given segment is completed, the corresponding pitch signal is automatically canceled even if the following pitch is identical. A new pitch signal is then generated for the duration of the following segment.

The result is that the synthesized speech tends to be more distinct than that produced by more standard methods where the filter parameters are varied at the end of one calculated duration period to accommodate the following period.

The CSELT quite naturally has so far focused its research on Italian speech. The method could be applied to other languages, however, by varying the phonetic inputs and duration and pitch algorithims.

The laboratory is working on a speech-recognition module—a more difficult part to build than the synthesizer. In addition to the obvious telecommunications applications, the CSELT expects the system to be useful in consumer and office-automation equipment.–**Robert T. Gallagher**

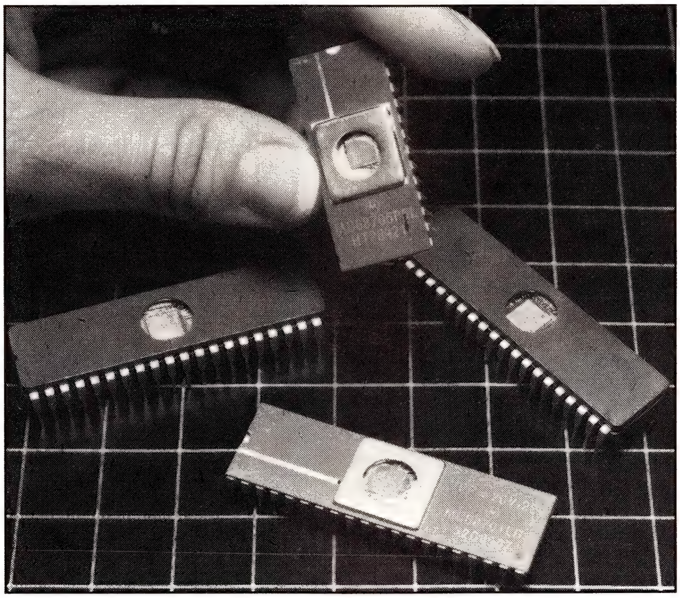
MOTOROLA CUTS PROCESSOR PRICES

Austin, Texas

In an effort to blow the cover off competing parts that feature one-time-programmable read-only memory, Motorola Inc. this month will aggressively cut prices on its ceramic-housed erasable-PROM-based microcomputer chips. One-time-programmable ROM on microcomputers is actually ultraviolet-light erasable PROM; dies come in windowless dual in-line packages made from less expensive plastic.

Motorola's move, to be highlighted at next week's Electro/85 in New York, is based on a new standard line of ceramic DIPs, which still features glass windows for UV-erasable PROMs. This cheaper DIP—unlike traditional, more expensive side-braze ceramic packages—was made possible by enhanced testing gear, high volumes, and increased assembly automation.

With the package, the company can cut the price of EPROM-based 8-bit microcomputers by between $10 and $15 each in lots of 5,000 pieces, says W. Wade Wyatt, Motorola's manager of technical marketing. In the low-cost DIP, Motorola's 68705P3 with 1.8-K bytes of EPROM will sell for $4.95 each in 5,000-piece quantities.



Price attack. Motorola Inc. this month will aggressively cut prices on its ceramic-housed erasable-PROM-based microcomputer chips. Through the price cuts, Motorola hopes to deal a crippling blow to its competitors.

The firm aimed its pricing strategy at least partly at the emerging line of 8-bit microcomputer chips from Intel Corp., which recently introduced components featuring one-time-programmable PROMs in plastic DIPs. To offer one-time-programmable parts, vendors have had to devise new testing techniques that probe the memory cells before sealing the chips in opaque plastic. Intel's 1-K PROM-based P8748H now sells for $9.90 in lots of 5,000.

Intel wants to carve out a new class of single-chip microcomputers between those with EPROM and less expensive, mask-ROM chips, says marketing manager Dave Yeskey. "Customers are telling us they have to make some hard decisions between 1,000 and 10,000 parts per year, per program code."

Prices to dive. Intel's one-time-programmable microcomputers are hitting the market with a price more than 2½ times that of mask-ROM components, but Yeskey promises prices will fall quickly. "We are going to drop [the price] down to two times that of ROM parts and will be just a percentage higher than ROM parts as we get into the start of 1986." He adds that EPROM-based microcomputers cost 4 to 4½ times more than ROM-based chips.

Motorola, however, has no current plans to offer EPROM microcomputers in plastic and is leveraging volume against the cost of ceramic. "Our studies have shown us that reprogrammability is a very key feature," Wyatt says. "So why go through the maze of getting another plastic package qualified when you can provide ceramic quality levels at very little price premium?"

Initially, the windowed-ceramic DIP will lower the cost of Motorola parts in its 68705 and 68701 8-bit families. Later this year, the company will offer the ceramic DIP for CMOS microcomputers.

The lower-cost ceramic packaging technology has existed at Motorola for years (as it has at a number of other chip suppliers), but the firm has offered it only as a custom package on selected products. For the most part, older side-braze ceramic DIPs have remained the standard package for UV-EPROM. But gains in automation, production, furnaces, and new testing equipment make the ceramic DIP more feasible because it needs fewer and less complex processing steps than side-braze packages, says Steve Marsh, marketing manager for Motorola's 8-bit line.

The ceramic DIP, called the S package by Motorola, also uses leadframes similar to those used in plastic packages. (With side-braze packages, leads are individually joined with the edge of leadframes. Side-braze packages also need an extra step to hermetically seal the top and bottom halves of the package; the S ceramic package is made as a single piece.)

As a result, Motorola believes more high-volume applications will begin using UV-erasable, reprogrammable microcontrollers, says Wyatt. EPROM-based parts traditionally have served as prototyping products for new systems and microcode because of their higher prices.

The use of 8-bit microcomputers has usually given way to mask-ROM parts whenever volumes approached 500 to 1,000 chips, points out Wyatt. With EPROM-based chips now selling for as little as $5 each, the conversion point is likely to be five times higher, he says. **–J. Robert Lineback**

KOREANS TRY FOR VCR REPLAY

Latecomers in the video cassette market hope to garner market share from Japanese through price cutting and high quality

□ *by Michael Berger*

Seoul

The Japanese, who controlled 97% of the world video cassette recorder market last year, now have a challenger. Like the legendary Rocky, the South Korean makers are facing heavy odds, but they're betting that with hard work, and a little luck, they'll give Japan a battle in the years ahead.

They've already gotten one break. Recent industry surveys show VCR shipments to U.S. dealers running at an annual rate of 12 million, considerably higher than the late-1984 Electronic Industries Association forecast of 9.5 million units.

MARKET FOR VIDEO CASSETTE RECORDERS
(BILLIONS OF DOLLARS, WHEN 250 YEN = $1)

Market area	1983	1984	1985 (est.)	1986 (est.)
U.S.	1.86	3.24	3.67	3.79
Europe, others	3.55	5.38	5.78	6.55
Japan	1.01	1.31	1.46	1.59

SOURCE: PRUDENTIAL-BACHE FAR EAST RESEARCH

The U.S. market may achieve 13% growth this year, with the South Koreans winning a 6% world market share by next year, according to an estimate by Prudential-Bache Far East Research's Tokyo office. The same report predicts that the U.S. market will be worth $3.66 billion this year, and $3.78 billion in 1986. Worldwide VCR production will reach 33.3 million units this year (up from 28.2 million in 1984), with further growth to 38.6 million in 1986, Prudential-Bache predicts.

The Korean export push is timed with the expiration of agreements with Japanese Video Home System patent holders, who transferred manufacturing technology to the Koreans in the early 1980s but prohibited them from exporting to the U.S. until this March. Even before Korean-brand VCRs hit the American market last month, however, they had surprised analysts with a faster-than-expected production ramp-up. The three largest makers expect a total capacity of close to 4 million units by the end of this year, more than triple earlier estimates.

The two major producers, Gold Star Co. and Samsung Electronics Corp., hope to ship close to 1.5 million VHS units to the U.S. by December, while a third firm, Daewoo Electronics Ltd., has less optimistic export plans because it is marketing Beta-format models. A recent Nihon Keizai newspaper survey revealed that Beta-format shipments slipped below 20% of world VCR production in 1984.

In yet another foreign technology tie-up, Tongwon Audio Component Co. of Seoul has signed an agreement with Philips-DuPont Magnetics B.V. to manufacture and market the Dutch firm's VCRs. Production and marketing will begin next year, with Southeast Asia rather than the U.S. the first target.

Besides the time lag of their late market entry, the South Koreans must overcome another obstacle: doubts about their ability to build quality products. Jang Ho Chung, managing director of Gold Star, brings the point up himself when he says, "We want to be known for the quality of our products, not the price." But the tag line of his firm's multimillion-dollar U.S. ad campaign says: "Expensive electronics. Without the expense."

Price slide. If Gold Star and Samsung meet their export goals, market analysts say it will cut Japanese growth in the U.S. market to just 16%, because Korean sets will be priced between $329 and $349, well below current levels. And that's just the start of what industry analysts expect will be a further slide in prices—to perhaps as low as $230 by year end.

Low-balling may push up sales, but Jong Yong Yun, executive managing director of Samsung Electronics' Video Division, emphasizes: "We've made a huge investment in VCRs and we can't earn a proper return by pricing our sets too cheaply. That's our biggest problem." He says his company will divide its first year's production evenly between its brand-name models and original-equipment-manufacturer work for such chain stores as Sears, J.C. Penney's, and K-mart. Gold Star plans a similar strategy, using its 2,500 color-TV dealer outlets to sell its VCRs.

The models the Koreans will be

Profit squeeze. Koreans cannot price their VCRs too cheaply, says Samsung Electronics' Jong Yong Yun, because of the huge capital investments they have made.

International. Samsung video assembly lines are currently located in Seoul and Great Britain, and may soon be joined by a new production site in Ireland.

marketing will include remote control and preprogramming functions as well as freeze-frame features, with three recording speeds that can extend tape loads to as much as six hours. "We're not adding more sophisticated features," says Yun, "until we build our reputation for reliability with these first models."

Good response. As for the quality question, Samsung's Yun says, "The Japanese are spreading rumors to forestall our advance, but our sample shipments to U.S. customers have gotten a very positive response. We're still facing some production problems—how to reduce the number of components and make the models even more compact, and these will take another two to three years to solve," he admits. "But we've had nearly five years' experience in building VCRs, so we feel we can compete with the Japanese right now." Already, he says, Samsung is producing a VCR that is just 96 mm high, "just about the slimmest on the market."

Another Japan-related problem for the Koreans is their dependence on Japanese components. Yun concedes that Samsung produces only about 50% of its VCR units. "We make our own drum head and key integrated circuits," he maintains, but the key microprocessors controlling VCR timer and programming functions all come from Japanese and U.S. makers, including Matsushita Electric Industrial Co., Toshiba Corp., and Texas Instruments Inc.'s plant in Japan.

Although Yun says his goal is to increase domestic content ratios to 80% or 90%, the present arrangement, even though it means depending on a competitor, has its own benefits. "The Japanese can produce these components more cheaply than we, so it makes sense to buy from them," he says. "And we're not worried about reliability of supply, either. The Japanese are making money on us; they're not going to cut off business."

The final problem facing the South Koreans is one they seem less concerned about: the emergence of the 8-mm video market. Both Gold Star and Samsung already have developed their own 8-mm systems, "but we're cautious about investing in this product," says Gold Star executive Chung. "We still feel that there's plenty of growth left in the VCR market. After all, the diffusion level in the U.S. is just about 40%."

In the home market, meanwhile, 1984 sales doubled, from a modest 140,000 to a still unimpressive 300,000. Just five years ago, however, only 2,000 VCRs were sold in South Korea. "Our market will take some time to mature, but in any event, our future lies in overseas markets," says Chung. Gold Star is even considering doing some VCR assembly in the future at its color-TV plant in Huntsville, Ala.

The other Korean makers also confirm that if they are to build market share and avoid the almost inevitable protectionist trends in the U.S. and Europe, they must eventually move some production to those markets. The Tongwan-Philips tie-up will lead to production in Europe, and Samsung and Gold Star, which already produce some audio and television products in Great Britain, also are said to be studying production sites in Ireland.

The ultimate key to that future, says Chung, may lie in building not only good products, but images. "People don't realize what a long history we have," he says. "And we've built our country—since the first national economic plan—in just 23 years. We couldn't have done that if we didn't have strong work and craft values." □

NAVIGATION SYSTEMS: IT'S ACADEMIC

St. Louis

Anyone familiar with machine vision also knows about the sheer complexity of teaching a machine to recognize a single object. And the difficulty of teaching a robot's computer to recognize several objects with the same program can seem almost insurmountable. But that's exactly what must be done to ensure the success of robot navigation, a major topic at the Institute of Electrical and Electronics Engineers Conference on Robotics and Automation, held here last week.

Significantly, marketing representatives from industrial companies—including startup robotics firms—were absent from most of the meetings. This could mean that a commercially successful autonomously moving robot is still a ways off. But the challenge of developing the theoretical underpinnings of robot navigation (among other topics germane to industrial robots) only piqued the interest of the several hundred industrial researchers and academics who were present.

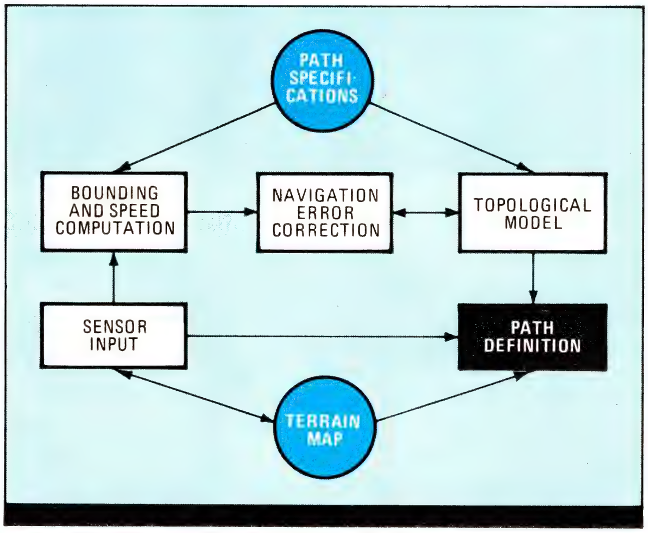
Novel approach. Jean-Paul Laumond of the Laboratoire d'Automatique du CNRS in Toulouse, France, took a novel approach to robot navigation. Instead of waiting for manufacturers to improve sensor accuracy, Laumond is content to use sensors as they are. He proposes a software solution—building a topological model defining general principles for dealing with the uncertainties of autonomous motion and writing a program so that a mobile robot can define its own reference landmarks as it moves.

“A major difficulty stems from the fact that the machine perceives its surroundings and keeps track of its position through sensors that are inevitably imprecise—either because of signal noise or inconsistencies in the data-interpretation algorithms,” says Laumond. He explains, “To rely on sensors alone means that a robot can navigate only if the circumstances of a local environment are known in advance and do not change in an unpredictable way.”

But the circumstances of a local environment do change; no factory has features whose movement can always be predicted. In Laumond's view, the most promising approach bypasses machine vision entirely, and relies instead on a laser rangefinder with an optical shaft encoder mounted on the robot's drive-wheel axis.

Simple plan. Laumond's logic is straightforward: by using simple hardware, computational power is freed from the task of interpreting images and can concentrate instead on matching sensor data (in this case, just an odometer track with obstacle detection) with a preprogrammed topological model.

Although Laumond claims the model can be programmed onto any 8-bit microcomputer, another conference participant, who requested anonymity, suggests that “what [Laumond] is proposing is a formidable artificial-intelligence task that would probably require an on-board VAX to deal with unexpected features in the factory landscape.”



A two-way street. Autonomous navigation requires interactive programming and real-time updates. But speedy processing probably means fast—and potentially expensive—hardware.

Alexandre M. Parodi of FMC Corp.'s Artificial Intelligence Center concurs. “If a path has already been planned at the global level, local modifications can be processed on board the robot using simple computations. But in the case of an unexpected blockade, a new global plan may be necessary—requiring massive computations within seconds.”

Like most of the conference participants, Parodi doesn't foresee immediate use of autonomously moving vehicles in industry. Instead, he and his associates are helping the Department of Defense to develop an autonomous land vehicle for battlefield reconnaissance [*ElectronicsWeek*, Nov. 5, 1984, p. 24].

Harder job. Regardless of application, Parodi believes that no single topological model is adequate to cover all the variables that an autonomous vehicle would encounter. His approach factors path planning into hierarchical levels, which, taken together, constitute an expert system whose experts are communicating with one another, and whose decisions depend on each other's partial conclusions. Therefore, Parodi explains, “in order to get a get a quick consensus, each level has to act fast.”

Fast action, however, requires fast hardware. The FMC design, which has not yet been prototyped in a vehicle, envisions nine identical TTL subcells to propagate each expert system's evaluation from one hierarchical level to the next.

The design's very large-scale-integration implementation, at switching speeds of 10 ns, requires 12,000 transistors per cell. Parodi says that a much cheaper CMOS gate-array version is being designed, but the question of when it might work to an industrial manufacturer's advantage is open.–**David M. Weber**

"HITACHI FAILED"

HITACHI

HONEYWELL INTEGRATES TEST GEAR

Littleton, Colo.

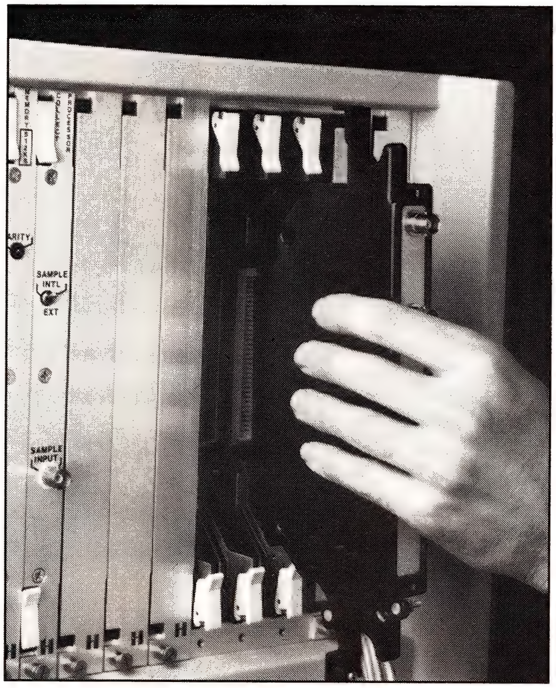
After supplying various segments of the laboratory instrumentation business for years, Honeywell Inc. is pulling together an entry into the market for fully integrated test systems. Forming a new product operation here, the firm will debut its H-TMS 3000 test-management system at Electro/85 later this month in New York.

Honeywell's Test Instruments Division, in the Denver suburb of Littleton, has packed the new tabletop unit with four 68000 16-bit microprocessors and a highly modified version of AT&T Bell Laboratories' Unix. The operating system splits its real-time kernel onto two different processor boards. The H-TMS 3000 also is built around a dual-bus architecture: it uses a standard VMEbus for general-purpose computing functions and a high-speed proprietary data-collection bus that accepts plug-in signal-conditioning and data-acquisition modules.

The result is an expandable self-contained test-management system aimed at a broad range of testing and control applications, such as those used in the heavy machinery, automotive, and aerospace industries. The system senses, stores, and analyzes sensor signals of changing conditions, such as temperature, voltage, current, pressures, and stress. It is capable of sampling rates ranging from 10 to 250,000 per second. Prices for the model 3000 start at $20,000.

The 3000 is the first in a line of test-management products that will probably be expanded to factory-floor and remote-field testing applications in the future. Having invested more than $10 million over three years to develop the system, Honeywell expects the business to become a major segment of its Test Instruments Division. In five years, the new Test Management Systems operation will employ about a fourth of the division's workforce, says Ira M. Langenthal, vice president of operations at the site. It now employs 1,200 people.

With the system's introduction, Honeywell enters into competition with a growing field of test-and-measurement modules that hook up to popular personal computers. Honeywell's system has a number of personal-computer-like features, including floppy-disk drives, 5¼-in. Winchester hard disk, graphics display, internal printer, and menu-driven software to guide users through programming steps.


New business. Honeywell Inc.'s first integrated lab-test system, the model H-TMS 3000, is based on four 68000 16-bit microprocessors and a modified form of AT&T's Unix.

But test systems officials in Littleton believe the two-bus, four-processor design will pack a lot more test-management wallop than conventional personal computers, which usually have a single central processing unit. "By using the four processors, we are able to distribute and speed up tasks under the real-time Unix operating system," explains John D. Tyler, product marketing specialist.

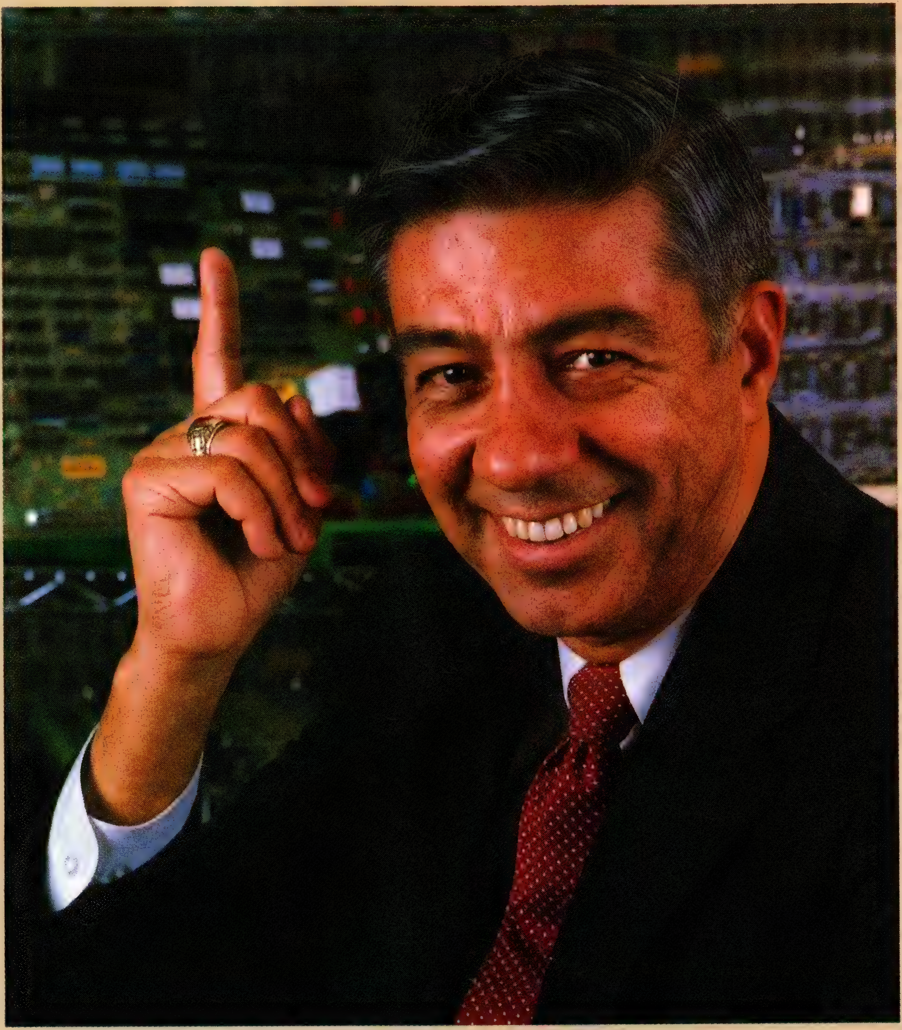
Honeywell modified a real-time version of Unix—called Regulus, from Alcyon Corp., of San Diego—to reside in two separate read-only memory chips. One ROM is on a 68000-based disk controller and the other on the controlling CPU module. Sixteen-bit 68000 chips also are used on a graphics processor and a collecting CPU that handles the flow of data between the VMEbus and the high-speed data-collection bus. The firm developed two custom integrated circuits for the collection bus, including the SMAC, for signal management and control, and the PSDI, for parallel-to-serial digital interface.

The data-collection bus has been designed to handle higher sampling rates in the future, ranging up to 1 million/s. Analog data from measuring sensors enters the system by means of signal-conditioning modules that plug into the collection bus. Analog-to-digital conversion is performed on the modules, and 16-bit data is sent to the VMEbus through the 68000-based collecting processor board.

Representing a major portion of the development project, the system's software includes menu-driven programs to set up and perform tests in either real-time or from stored data on either floppy or hard disk. Setup software is intended to reduce the time used to ready tests. Tyler says that Honeywell believes 80% of test time is spent in setting up equipment.

With its new product, Honeywell also will be going head on with Massachusetts Computer Corp., which earlier this month shipped its thousandth MC500 system. Like the new Honeywell system, Masscomp's two-year-old MC500 is based on multiple 16-bit 68000-family microprocessors. It also has a triple-bus architecture using a proprietary system bus, a standard STD bus for data-acquisition modules, and a Multibus for peripherals. **–J. Robert Lineback**

"JUST ONCE!"



"After buying over 500,000 Hitachi DRAMs, we experienced just one failure."

Carl Dantas, President of Compugraphic Corporation, makers of computerized typesetting systems: "We put quality first—and our customers appreciate it. Only one Hitachi memory part has failed in an installed Compugraphic system. In fact, Hitachi's quality is so high we've eliminated our normal 100% incoming inspection on their 64K and 256K DRAMs. Random sampling of these incoming Hitachi parts shows practically no rejections. We think that's amazing. Most other suppliers don't even come close to that kind of uniform reliability. You can bet we'll be using other Hitachi products in the future."

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BROAD USE SEEN FOR NARROWBAND

Making room for everybody in the crowded 800-to-950-MHz spectrum requires some fancy footwork in narrowband technology

☐ *by John Wengler*

New York

Had Woody Guthrie been talking on a cellular telephone along that ribbon of highway, his chorus might have been, "This band was made for you and me."

But today there isn't room for everybody in the 800-to-950-MHz spectrum, and once the final 32 MHz of spectrum reserve is allocated, the only long-term solution seems to be squeezing more channels out of existing bands. Narrowband technologies already exist that increase spectrum efficiency sixfold, and digital transmission schemes promise more data per channel. But their wide-scale use would require replacing every standard radio in the country.

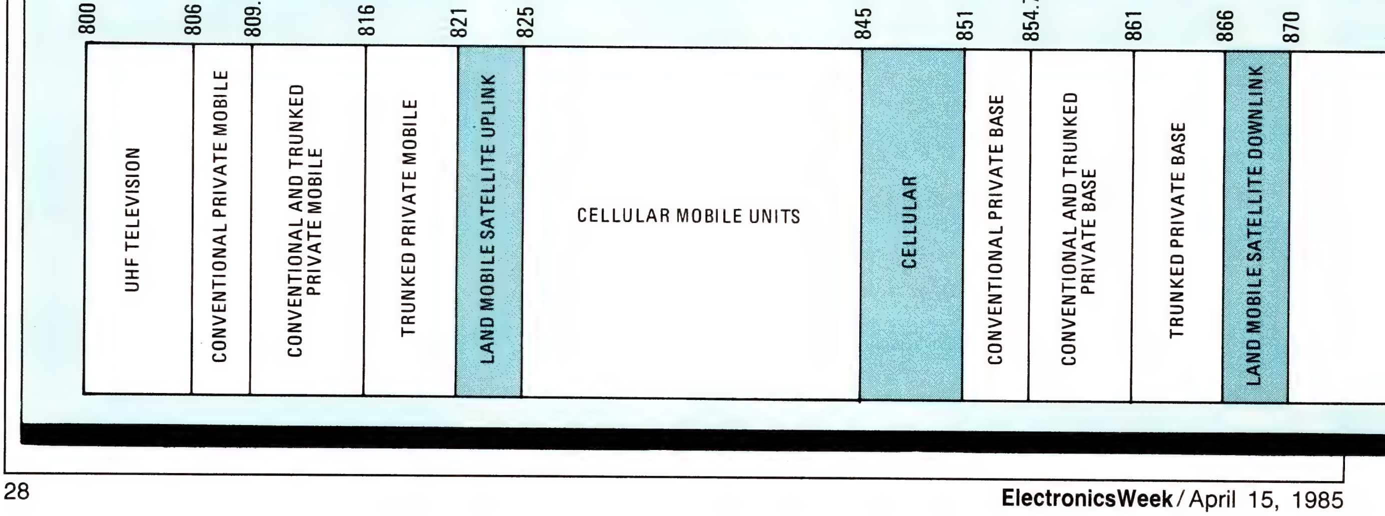
"There is no alternative to narrowband technology—it's undoubtedly coming. The only question is when," argues one radio manufacturer. Narrowbanding recently got a boost when the Federal Communications Commission allowed the use of the technology in 150-to-170-MHz land mobile communications—the two-way radios that are used in taxis and police cars [*ElectronicsWeek*, March 11, 1985, p. 13].

"The commission's move is at least a start toward revolutionizing the use of the spectrum," says Hal Davis, a vice president at Aerotran Inc., Raleigh, N.C., one of two firms making narrowband radios using amplitude-compandored single-sideband transmissions. ACSSB compandors compress outgoing 30-kHz signals into 5 kHz and then expand the signals once they are received.

Because of the FCC decision, the other ACSSB manufacturer, Stephens Engineering Associates Inc., of Mountlake, Wash., expects a boost in sales from $2.5 million in 1984 to an estimated $35 million in 1989. Stephens' president, David Thompson, notes he has already seen "a noticeable increase in activity toward purchasing equipment."

Some doubts. But ACSSB still raises doubts, even among proponents of spectrum efficiency. "I think ACSSB is the last gasp of analog techniques," declares George Calhoun, vice president for planning at the International Mobile Machine Corp., in Philadelphia. The firm is developing digital schemes to transmit four conversations simultaneously over a 25-kHz channel. "Right now we're equal to ACSSB," says

Battleground. The crowded territory of 800 to 950 MHz has several hotly contested enclaves. Land mobile shares spectrum with a variety of services with growing frequency appetites, including cellular telephones and mobile satellites. Proposed allocations are shown in color.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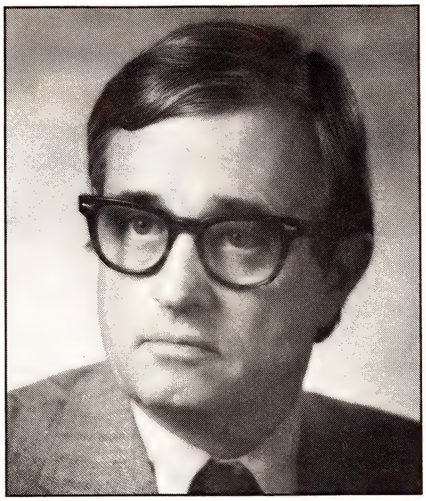
Calhoun, adding that digital is more cost-effective because it requires one repeater for every four needed for ACSSB using the same bandwidth.

The goliaths in the field, such as Motorola Inc., as well as the Electronic Industries Association, actively opposed the FCC's liberation of narrowbanding. Critics complained that makers of standard FM radios resisted the technology because they were not prepared with a new product line. But Motorola opposed narrowband techniques because of "the worldwide direction toward digital," according to Carol Rappel of the firm's business planning office.

And up the spectrum. As the analog-versus-digital battle wages in the 150-to-170-MHz range, the issues become more complex in the 800-to-950-MHz range, where land mobile shares the spectrum with a variety of services with growing frequency appetites, including cellular telephones and mobile satellites. Last fall, the FCC proposed distributing the final spectrum reserves among these three interests: 12 MHz to cellular, 12 MHz to land mobile, and 8 MHz to mobile satellite communications.

As an option, the commission proposed requiring that 2 MHz of cellular's new 12 MHz operate with channel widths of 5 kHz. The proposal claimed "the additional 2 MHz using narrowband channels would be the equivalent of 12 MHz . . . using the present 30-kHz channeling."



More sales. David Thompson has seen sales increase in ACSSB-compandored equipment since the FCC allowed narrowbanding in 150- to 170-MHz two-way radios.

Narrowband technically can operate in the 800-to-950-MHz spectrum. Researchers at the University of Bath, England, have solved the feed-forward problems that plagued the first generation of ACSSB radios operating at these frequencies. E.F. Johnson Co., of Waseca, Minn., manufactures an air-to-ground telephone called Airfone that transmits over 6-kHz channels in the 800-MHz band. Although the Airfone worked, the idea as a whole did not fly with the FCC, which rejected permanent licensing last fall.

Even AT&T Co. appears to be lining up behind narrowband. In its comments to the FCC, AT&T estimated that narrowband technology would account for half of the cellular transmissions in New York, Chicago, and Los Angeles. So AT&T proposed that 10 MHz be allocated for narrowband use, plus 12 MHz for standard radios.

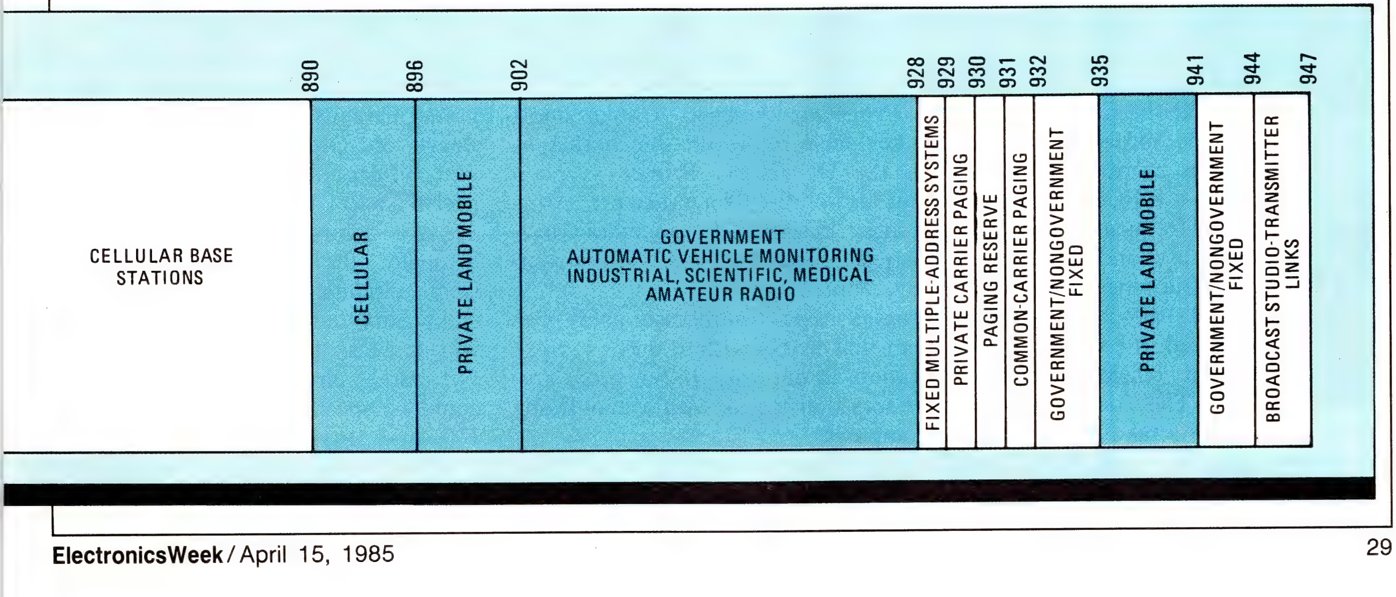
One consultant, however, said the chances that the FCC will go through with the narrowband option remain "pretty iffy." Now, companies are more interested in claiming new spectrum than reusing what they already control. "It's always easier to give up spectrum than it is to get it," says Cliff Higerson of Hambrecht & Quist Inc., a San Francisco investment banking firm.

Cellular's short term. Ameritech Mobile Communications Inc. initiated this FCC action by asking for an addition to cellular's 40-MHz allocation last fall. One of Chicago's two cellular operators, Ameritech claims that it needs more spectrum to avoid the high cost of cell-splitting as consumer demand increases.

Since 1983, Ameritech has added eight new cells and split six of the original 17 cells. But the company argues that demand will grow from 15,000 to 60,000 users in the next 15 years, and expansion costs will become critical. If it receives part of the 12 MHz proposed for cellular, Ameritech would not have to split as many cells to absorb new demand. With the extra spectrum, Ameritech will need only 61 rather than 91 cells, and thereby save an estimated $38 million.

"Our position is that we don't want to be forced into using any technology," explains David Brian Wood of Bell Atlantic Mobile Systems, which provides cellular communications equipment to Philadelphia, the Washington-Baltimore area, Pittsburgh, and Pennsylvania's Lehigh Valley. "We want to use [spectrum-efficient technology] when it makes economic sense."

Some of those opposed to cellular's gaining spectrum claim that the estimated savings of $8 a month per cellular subscriber does not warrant



the extra spectrum allocation. Other critics question the fairness of allocating more spectrum for the benefit of only the few big-city markets with capacity problems.

One proposed FCC compromise is to allocate the same band for cellular in cities and for private radio in rural areas. But chances are slim for adoption of this proposal because of the difficulty of preventing interference.

Regardless of the costs to revamp existing bases, many observers believe the FCC must plan for the future and begin to require more efficient use of spectrum. "It's a question of where we want to be 20 years from now," says Corwin Moore, director of the Personal Radio Steering Group.

Plan for the future. The group presented a master plan to the FCC for converting to narrowband. The first phase would require new radios to offer both standard wide and new narrow channels and the second would mandate narrowbanding in every new radio. Although both wide and narrow transmissions would be allowed in the first two stages, the FCC would allow only narrowband during the third phase.

The Association for Maximum Service Telecasters proposed a similar transition. To avoid losses caused by replacing installed radios, the association proposed a time equal to the equipment's life cycle. Dale Hatfield, the consultant who wrote the proposal, explained the FCC should pressure industry into using narrowband, but the commission could also offer incentives such as allowing the leasing of new channels created from dividing wide bands.

The two groups advocate more efficient use of land mobile and cellular frequencies: both want more spectrum for their own use. The FCC refused to expand the personal radio service, but the broadcasters are afraid to lose any more spectrum. In the early 1970s, the FCC reallocated some ultrahigh-frequency channels for land mobile use, and the association wants to avoid repeating history.

But the FCC's allocation scheme remains a proposal: the various interests can submit official comments until April 22. The commission expects that it will take a few more months to consider public comments and make its decision. □

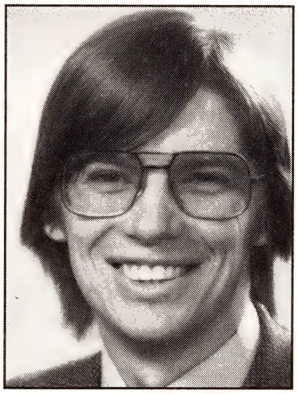
COMPUTER-AIDED DESIGN

MICROPROCESSOR ARRAY SPEEDS SIMULATION

London

Simulating a complex very large-scale integrated circuit by conventional means can take hours or even days of computer time, and the problem is getting worse as chips get larger and more complex. Thus a search is on for shortcuts, and at Brunel University, Uxbridge, near London, researchers think they have a promising one in the works.

They intend to exploit the inherent parallelism in circuits by modeling them node for node on an array of cooperating microprocessors. Because iterative calculations can then be made simultaneously for groups of nodes, rather than doing them for the entire circuit, simulation times can be cut by several orders of magnitude, depending on the circuit's complexity.



Accelerator. Brunel University's Anthony Ambler says circuit simulation can be speeded up remarkably by exploiting the inherent parallelism of circuits.

In the Brunel setup, each microprocessor in an array will have communications links to its nearest neighbors, and the array will be tied to a single global bus through a control processor. The whole lot will be tied together with operating software written in Occam, Inmos Ltd.'s computer language for concurrent programming.

Processor hungry. Unlike most other accelerators on the market or in the laboratory, Brunel's version can also be used for other processor-hungry design tasks, including test-pattern generation and circuit-routing. Moreover, the setup can grow from a basic 10-processor-array system that works with a low-cost work station, to one with 100 or more processors that works with a mainframe computer.

According to Anthony P. Ambler, who is working on the project with Roy L. Manning, the Brunel accelerator could readily find a market niche between inexpensive work-station accelerators and large and costly high-performance systems. The performance spectrum is wide and will get wider.

Low-end work-station systems such as Daisy Systems Corp.'s Megalogician can evaluate 100,000 gates per second. At the high-performance end of the commercial market is Zycad's Logic Evaluator [*Electronics-Week,* Feb. 25, 1985, p. 44], which can evaluate 60 million gate operations/s. And in research, an accelerator used internally by IBM Corp. whizzes through 960 million gate evaluations/s.

The Brunel solution, still at an early stage, has been confined to software simulations. But Ambler is talking to a British company about making a commercial product, and the two organizations are submitting a proposal to Esprit, Europe's fifth-generation computer effort, to make a simple nine-processor hardware demonstrator.

In a paper to be presented at next month's Institute of Electrical and Electronics Engineers' Custom Integrated Circuits Design Conference in Beaverton, Ore., Ambler will report that a thirtyfold speedup can be expected over the industry-standard Spice 2 computer-aided-design software for the transient analysis of small circuits. And as the circuit complexity increases, the differential will increase by leaps and bounds. For large circuits, the simulation could be speeded up by as much as 100 times, says Ambler.

Brunel's accelerator is a circuit, rather than a logic, simulator. That is to say, it can be used to model a circuit's transient operation, showing glitches and logic races. However, the setup could also be used for both circuit and logic simulation. "One array of processors could be performing logic simulation while another array analyzes another part of the circuit, in a more detailed circuit analysis. The same architecture can also be used for automatic test-pattern generation and placement and routing," says Ambler.

Sharing the load. Brunel's scheme speeds simulation by sharing the task among groups of processors, each emulating a different chunk of the circuit. VLSI circuits, containing many thousands of transistors, would be mapped onto the array a batch at a time until the entire circuit had been simulated. To exploit the circuit's latency—that only 10% of its logic is active at any moment—the simulated circuit is mapped onto the array in a number of smaller modules rather than in one large module.

By exploiting the inherent parallelism in circuits, Brunel University researchers say they can slash circuit-simulation times

For example, a circuit with 1 million nodes could be partitioned into 400-node modules and the modules simulated in series on a 400-processor array. But if only one or a few circuit nodes or processors were active in the module, the other 399 or so processors would lie idle.

Small is better. Thus smaller blocks are better because some inactive sections of the circuit can be skipped. And even when only one processor in an array is busy, if the array is small, the overall processor utilization is still higher.

To put its ideas to work in hardware, Brunel will first build a small nine-processor array, using the Motorola 68020 32-bit microcomputer. Once running, the array could quickly be scaled up. Inmos's transputer was one likely choice for the task but "this lacks a floating-point coprocessor," says Ambler. Brunel will therefore program the 68020 microprocessor in Occam. –**Kevin Smith**

LASERS

CNET TAKES PRESSURE OFF LASER PRODUCTION

Bagneux, France

Using atmospheric pressure, a team of French researchers has produced what it claims are the first 1.3-μm lasers fabricated using metal-organic chemical-vapor deposition (MOCVD) with threshold-current densities low enough to be considered industrial quality.

These results, obtained at the Centre National d'Etudes des Télécommunications' principal laboratory for III/V materials research in this Paris suburb, could well herald serious competition for low-pressure MOCVD as the method of choice for high-volume laser production. Atmospheric-pressure MOCVD means increased material growth rates and more efficient use of materials and requires a much simpler, less expensive reactor.

Under the maximum. The CNET laser's current densities were as low as 1.2 kA/cm^2, only one third the figure achieved recently by AT&T Bell Laboratories in an experiment with a parallel objective, and well below the 2 kA/cm^2 that engineers consider the maximum for industrial use.

Even more encouraging is the fact that these figures were obtained on the laboratory's first attempt at producing lasers with this method, and are only some 40% higher than the world-record low-pressure MOCVD results published by the Central Research Laboratory of Thomson-CSF in nearby Corbeville.

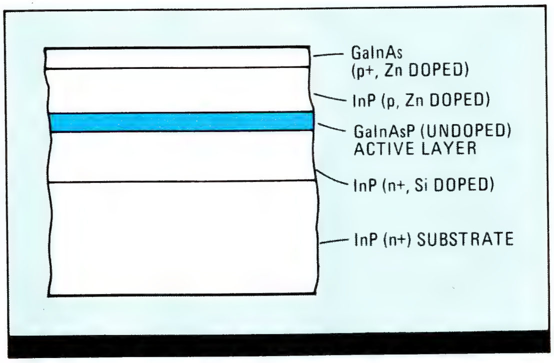
André Mircea, the CNET engineer coordinating the project, reckons that with future modifications in the fabrication process he should be able to at least equal the Thomson figures. Matching low-pressure densities would give the atmospheric method a clear competitive advantage.

Diffusion sources. Mircea is reluctant to speculate about why his results are three times better than Bell's. He points out, however, that the CNET's epitaxial-growth reactor developed in house relies on diffusion sources for its metal-organic compounds instead of using the standard bubbler method. Dopants and epitaxial flow rates are also different.

Fabrication of the CNET lasers begins with a 300-μm-thick indium phosphorus substrate (n^+) on which are grown four successive epitaxial layers: silicon-doped InP (n^+) 0.9 μm thick; an undoped 0.17-μm-thick gallium indium arsenic phosphorous active layer; 1.7-μm-thick zinc-doped InP (p^+); and 0.5-μm-thick zinc-doped GaInAsP (p^+).

After the substrate is lapped down to a thickness of 100 μm, gold-germanium and gold-zinc contacts are evaporated on the n and p surfaces respectively; a 100-μm-wide mesa-structure is then etched chemically in the gold-zinc contact layer.

Following this, metal contacts are deposited, after which a 1,000-Å-thick titanium layer and a gold film twice that thickness are evaporated on the p side. Finally, a standard cleaving technique yields individual lasers with cavities that range from 250 to 1,000 μm.–**Robert T. Gallagher**



High and wide. The CNET produces lasers in a double heterojunction structure by atmospheric-pressure MOCVD. Threshold currents approach those obtained with the more complex low-pressure method.

VISION SYSTEM CUTS BOARD REWORK

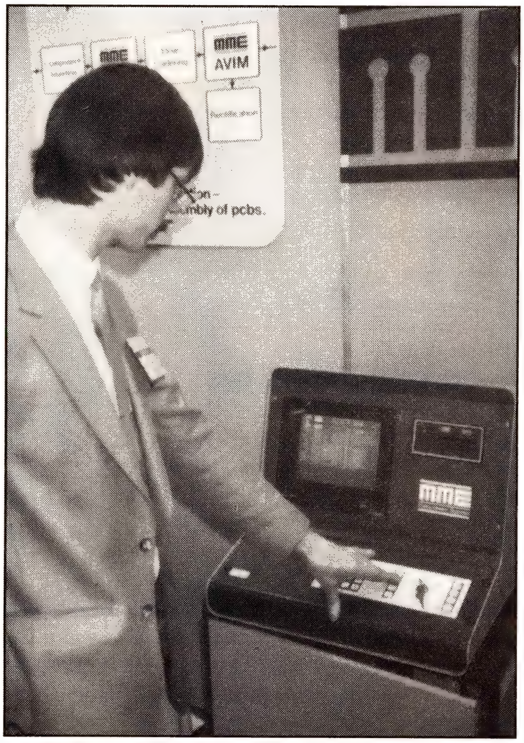
London

One of the first machine-vision systems to nail down a full-time job as a production-line worker in the British electronics industry is keeping an eye on assembled printed-circuit boards to make sure, before they are dip-soldered, that everything is on board and in the right place.

The watch is taking place at the London-area Watford plant of Computer and Systems Engineering Ltd. (CASE), a fast-growing manufacturer of data-communications gear. There, a $70,000 four-station machine-vision system, developed by CASE and Micro Measurement Engineering Ltd., Saffron Walden, Essex, keeps watch on the company's manually operated batch-production line. The $70,000 investment has broken an inspection logjam and will pay for itself within nine months by reducing board rework from 27% to 15%, says John Aylott, production director at CASE.

Many varieties. CASE makes more than 82,000 pc boards of 120 different types a year, 40% of them on batch production lines in runs ranging from 50 to several hundred boards. For these, manual assembly is cheaper and more flexible than automatic insertion but also much less reliable, Aylott says. Typically, a pc board measuring up to 18 in. on a side with upward of 640 components might have two components missing by the time it gets to solder dipping, he explains.

"We tried using a team of inspectors to check the boards, but that did not help too much. I also considered using optical comparators—which present the inspector with images of a known-good board and a test board in sequence—but after I had tried one for half an hour, I decided I would never have one in my factory. They are enough to drive you berserk," Aylott says.



Keen vision. The CASE machine-vision system can store up to 350 digital images of known-good pc boards on a hard disk.

Automatic inspection seemed to be the only answer, but a 1983 shopping trip to the U.S. failed to unearth anything suitable. Later that same year, Aylott spotted Micro Measurement's inspection gear at Munich's Productronica exhibition, where it was being used to inspect keyboards. The two companies then collaborated to develop a system for pc-board inspection.

Superhuman. The resulting system can inspect in 20 to 45 s a board measuring 18 in. on a side typically holding 640 components. A human operator would usually spend about 20 min per board—a tiring and error-prone task. Aside from spotting missing components, Micro's gear can also examine the underside of a pc board to check that leads have correctly penetrated the board to the tracks on the far side and that they are securely turned over. It will also check for solder splashes after solder dipping, says Aylott. Later this year Aylott expects to add a software feature so that the machine can identify integrated-circuit package labels.

Like its optical-comparator counterpart, Micro Measurement's pc-board inspection system works by comparing the test board with a known-good board. Instead of making a visual inspection, the equipment does it by the numbers—comparing a known-good board's digitized pattern with a digitized image from a charge-coupled-device camera. No programming is necessary.

The system comprises the CCD camera, a computer-controlled X-Y table in which the pc board is fixed, and a combination of dedicated hardware with software control, programmed in machine code for highest performance. The combination gives his kit a unique speed advantage over other systems, claims Brian M. Hopkins, Micro Measurement's managing director.

In operation, the site of any missing component shows up green on the color display. The 1-mm resolution helps identify misaligned or canted components. With a hard disk attached, the system can store images of up to 350 known-good boards. There are also facilities for connection to such automated production gear as bar-code readers.

Automated line. Although Micro's first system is working on a manual production line, its second will be used by the Graetz Gmbh, a maker of consumer electronics gear in Bochum, West Germany, to inspect pc boards bearing surface-mounted components. Without legs to guide them into position, these miniature devices can float sideways on their adhesive as they are glued in place. So machine vision has a big role to play, checking that surface-mounted components are correctly aligned to their pc boards, says Hopkins.

He adds that Micro Measurement's machine-vision system can also be used to inspect computer keyboards and to spot defects in liquid-crystal displays. **–Kevin Smith**

CALIFORNIA GETS ITS FIRST NSF CENTER

Santa Barbara, Calif.

Blessed with thousands of high-tech firms and many top engineering schools, California would seem to be the natural place for many of the 25 University/Industry Cooperative Research Centers that have been spawned by the National Science Foundation since 1978.

Surprisingly, the state has none of them. But that situation is about to change. The Golden State's first NSF-sponsored center is scheduled to get under way later this year at the University of California at Santa Barbara. What's more, a second NSF-sponsored center at the school, for semiconductor fabrication research, is in the works (see "Second UCSB center approved by NSF," below).

California may only have its good fortune to blame for this situation. "This state already has so many well-supported programs, at places like Stanford University in very large-scale integration, for example, that we have been concentrating elsewhere," says Alex Schwarzkopf, manager of the programs for the NSF in Washington.

Outpaced. Further, the NSF program charter—to provide counsel and seed funds for leading-edge research, subjects that industry has not addressed on its own—is often outpaced by fast-moving events at California companies and universities.

Indeed, only a handful of the NSF's Industry/University Cooperative Research Centers deal with electronic technology. Most have been directed toward such lagging fields as welding and steel processing. But the pace of forming high-tech centers could pick up markedly as advantages become more apparent, officials think. A tip-off is how quickly support flocked to the center devoted to optical circuitry set up at the University of Arizona last fall, along with the emergence of the UCSB project.

At a key planning meeting at UCSB late last month, 15 firms signaled their intention to take part in the center, which will research high-speed image-processing technologies.

Although these firms still must come through with formal approval from top officials (along with the $50,000 annual fee), their initial support makes it likely that at least 10 companies will actually join the center. Usually, two to three months pass before all approvals are in hand, observes Schwarzkopf.

Discussions. Give-and-take talks among company representatives and Center officials about proposed UCSB research projects point up the most difficult question faced by any such program. "The conflict between generic research and specific applications continually has to be dealt with," notes the NSF manager. Things work best when firms realize that basic research performed by the centers best serves their needs, with product development then being done entirely by the companies, he notes. An advisory panel, on which all firms sit, thrashes out such questions with research-center managers.

The UCSB center's path toward a projected fall opening started several years ago under the impetus of James L. Merz, associate dean for research development in the College of Engineering, a school noted for its work in image-processing technology. NSF supplied the funding for planning and writing a proposal, which was used to drum up interest among prospective supporters. The major attraction: buying the time of top academic researchers for a bargain-basement price.

UCSB, which had its first meeting for industry in 1984 [*Electronics,* May 3, 1984, p. 50], has a proposed first-year budget for the center of about $600,000, with $100,000 coming from NSF. The state's next center, set for the University of California at Berkeley, will focus on on-chip sensors in very large-scale integrated circuits. Keen interest in the project makes its opening a "virtual certainty, possibly for later this year," Schwarzkopf says. **–Larry Waller**

Second UCSB center approved by NSF

California's luck with the National Science Foundation is changing rapidly. The NSF has just approved funding for a second engineering center at the University of California at Santa Barbara. The university will receive up to $14 million over the next five years to develop robotics systems for semiconductor fabrication. This center is one of six just-announced engineering centers for which the NSF is granting a total of $94.4 million. "We wanted to put new money into engineering," says an NSF spokesman in explaining the new grants.

The NSF, which chose from among 142 proposals from 106 institutions, selected projects from four individual schools and two cooperative efforts. Besides UC Santa Barbara, the other schools chosen are Columbia University, which was granted $20 million for integrating data, facsimile, graphic, and voice telecommunications; Massachusetts Institute of Technology, which will get up to $20 million for a center for biotechnology process engineering; and Purdue University, which will receive $17 million to focus on the automation of batch manufacturing for discrete products.

In joint efforts, the University of Delaware and Rutgers University will spend $17.5 million for a center on composite manufacturing science and engineering, while the University of Maryland and Harvard University have been awarded $16 million to perform basic research on the application of very large-scale integration for semiconductors, computer-aided engineering, and artificial intelligence in the design of interactive automatic control and communications systems. **–John Wengler**

GERMANS PUSH X-RAY EXPOSURE

Industry and government cooperate to establish X-ray lithography as a major technique for chip making by the early 1990s ☐ *by John Gosch*

West Berlin

A multicompany, government-supported national project here holds the key to West Germany's hopes of carving out for itself a leading position in semiconductor manufacturing technology by the early 1990s. The project's initial goal, to be reached by the end of 1988, is to show that X-ray lithography is a workable means of producing chip structures well into the submicron range, and a technique that can be used not only in the laboratory but on an industrial scale.

The aim is to demonstrate that X-ray lithography, based on parallel, high-intensity synchrotron radiation, is suited to produce dense and complex circuits with feature sizes down to 0.7 μm—for example, 4-Mb dynamic random-access memories. This summer, a pilot line for such parts will be started up. After 1988, the work will be aimed at making higher-density DRAMs with structures as small as 0.3 μm; 16-Mb memories and other parts with such sizes are envisioned as commercial products during the first half of the next decade.

National effort. Virtually all West German semiconductor makers are participating in the project. The lineup includes Siemens, Telefunken, Eurosil, and Valvo, a subsidiary of Philips. Heading and coordinating the effort is the Institute for Microstructure Technology, one of 32 government-supported research institutes run by the Fraunhofer Society.

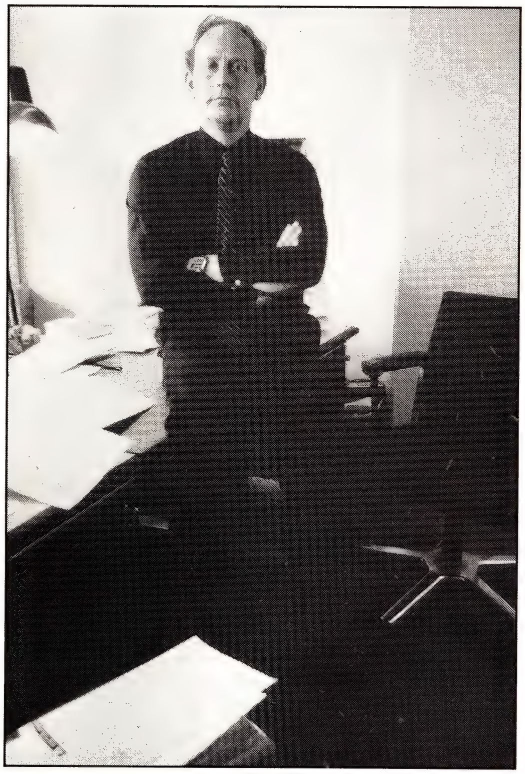
The project dates back to 1978, when the German semiconductor industry began considering alternative techniques to overcome the resolution barriers of optical lithography. Electron-beam techniques, favored earlier, are well suited to mask making but are too slow for direct writing on wafers and hence for mass production of chips.

The alternative the industry settled on was X-ray lithography. With X-ray wavelengths about 500 times shorter than those of light, the technique permits a high resolution. What's more, in contrast to electron-beam techniques that entail a dot-by-dot writing process, X-ray lithography is a parallel process. This means that a fairly large field on the wafer can be exposed in one shot.

Experimental results obtained to date during the project's preliminary phase show that a structure resolution of 0.2 μm is achievable. An exposure field from 10 to 20 cm^2 on the wafer can be used even at feature sizes well below 0.5 μm.

Since 1978, Bonn's Ministry for Research and Technology has allocated about $50 million to X-ray lithography work. In terms of scope and progress made, the project is "unique in the world," declares IMT director Anton Heuberger, who heads the effort. But he is quick to add that the Japanese, who kept a low profile in the field until two years ago, have lately made big strides. "We must make sure we keep our present lead," Heuberger says. "The threat comes from Japan, not so much the U.S."

As Heuberger sees it, West Germany does not have the resources to catch up with the U.S. and Japan in all aspects of semiconductor technology. "So we have consistently been an also-ran," he says. "Thus, be-



Project leader. Anton Heuberger, who heads the X-ray lithography project in semiconductor technology, calls the effort "unique."

cause of our limitations, we must concentrate on specific aspects, and one is XRL."

For projects of this size, individual firms in Europe, even big ones, Heuberger notes, lack the money and resources. A strong believer in multicompany cooperation, he cites the Philips-Siemens partnership in high-density-memory development [*ElectronicsWeek*, Oct. 29, 1984, p. 28] as an effort likely to succeed.

Heuberger is equally sanguine about the success of his project. "If not the leader in XRL by the next decade, we will at least be a partner of equal ranking, one taken seriously by Japan and the U.S.," he says. The German government plans to do its share. It is financing a $35 million laboratory at the IMT and will bear half the cost of operating the new facility. The other half will be paid by the four semiconductor firms involved.

Each firm is investigating a certain aspect of X-ray lithography. Siemens AG, for example, together with Karl Suess GmbH of Munich, is developing an X-ray wafer stepper, while other companies are working on suitable X-ray-sensitive resists. The main thrust, however, is in mask technology, with each of the four semiconductor firms looking at specific mask substrate materials such as silicon, silicon nitride, silicon carbide, or magnesium metal foils.

Contributing to the work are a host of other firms, as well as institutes and universities. Besides Karl Suess, there is the chemical giant Hoechst AG which, together with the Fritz Haber Institute, is helping in resist development. The Technical University of Darmstadt and the Hahn-Meitner Institute of West Berlin's Technical University will also take part in the project.

Bessy's help. Another key contributor is the Berlin electron storage ring for synchrotron radiation, or Bessy. Built for basic research purposes ranging from chemistry to electronics and tapped by various research facilities, Bessy is the source for the project's synchrotron radiation at X-ray wavelengths.

This type of radiation is produced by electrons as changing magnetic fields guide them along a 20-meter-diameter storage ring at near-light speeds. The IMT, housed in the same building, is the prime user of Bessy's synchrotron radiation.

Synchrotron radiation is used as an X-ray source not only because it makes for high-intensity parallel rays but also because its spectral range can be varied fairly simply within certain limits by varying the radiation energy in the synchrotron. Also, synchrotron radiation is suited to silicon lithography because it adapts well to the spectral sensitivity of available resists and to the substrate and absorber materials common in various mask concepts.

Cosy ring. An X-ray source of Bessy's dimensions is impractical for use in a semiconductor fabrication environment, so work at the Bessy and IMT facilities is also aimed at a highly compact, low-cost X-ray source for industrial applications. Nicknamed Cosy, for compact storage ring for synchrotron radiation, it will have a storage ring two to three meters in diameter and will occupy only about 30 m^2 of floor space.

An exposure station incorporating the Cosy source and an X-ray stepper is expected to have a throughput of 50 to 80 wafers an hour, even at pattern sizes down to 0.3 μm. Its costs should be less than those of present optical wafer steppers, Heuberger predicts. A prototype version of such a station should be ready by the end of next year.

Besides providing high resolution and parallel mask processing, X rays with 0.2- to 2-nm wavelengths (called soft X rays), such as the Berlin group is using, have a number of other advantages over competing exposure techniques. One is that X-ray lithography does not call for complex pattern-transfer processing of multilevel resist systems.

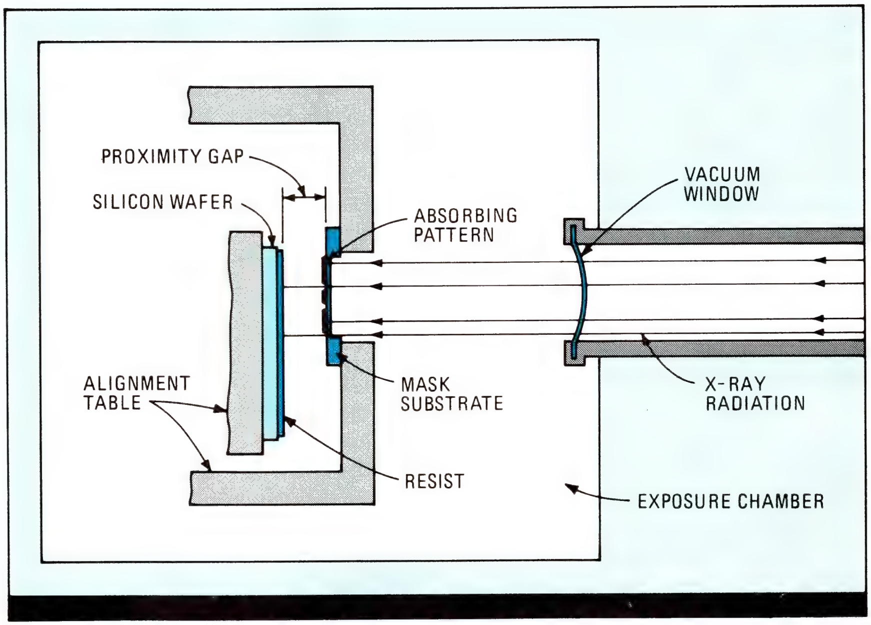
With X-ray lithography, diffraction effects pose no problems for structure sizes down to 0.2 μm. Moreover, pattern distortion is negligible at these feature sizes, which means that proximity effects, common with electron-beam writing, are all but absent.

Further, it is insensitive to dust, which makes for lower defect densities. Finally, it is possible to produce thick resist structures with vertical edges and very high aspect ratios without sacrificing depth of focus.

In practice, parallel X rays at wavelengths from 0.2 to 2 nm impinge upon the mask and silicon wafer. Both are precisely aligned with each other and separated by a 40-μm proximity gap (see figure).

X-ray illumination is over a broad spectral range to reduce diffraction effects and to make good use of radiation intensity. Wafer exposure is in several steps, similar to optical wafer stepping, according to the familiar step-and-repeat technique.

Although its basic principles are simple, the technique's imaging sys-



Exposed. The X-ray lithography method exposes wafers to synchrotron radiation. Parallel X rays at a wavelength between 0.2 and 2 nm impinge on the mask and resist-covered wafer, producing a pattern.

tem still calls for the solution of a few problems both in mask and resist technologies as well as in mask-to-wafer alignment before it can go into widespread industrial applications, Heuberger says. In mask technology, the main problem is to ensure a registration accuracy of at least 0.05 μm with a mask substrate that supports the absorber patterns and is made of foils of different materials.

To get a sufficiently high dose of X rays at the areas on the resist that are not masked by the absorber patterns, a thin, light-metal foil, on the order of a few microns thick, must be used as a mask substrate. The materials best suited for this substrate foil are silicon, silicon compounds, and boron nitride.

For the absorber material, a gold or tungsten foil 0.3 to 1.0 μm thick, depending on contrast requirements, gives the best results. The problem is to have absorber materials with vertical walls and sufficiently high absorption coefficients, and to produce small structures with the required accuracy.

Thin, but tough. Resist materials must be developed that exhibit sufficient X-ray sensitivity at high resolution and at the same time must stand up to etching cycles. This is a prerequisite for retaining the proven single-layer resist technology for X-ray lithography techniques.

Optimum values must be found for the resist's sensitivity and stability, characteristics that run counter to each other. The resists that the researchers have been using so far as a reference in exposure experiments exhibit excellent resolution characteristics, but their sensitivity of around 1,000 J/cm^3 is too low for X-ray lithography applications.

Finally, wafer-to-mask alignment problems need to be solved. For 0.3 μm structures, a positional tolerance of at least 0.05 μm is required. For alignment purposes, the German researchers are considering using laser light instead of X rays because for light wavelengths there are very efficient components available. Also, the energy density of lasers is high enough to allow the use of very small registration marks. With the X-ray stepper being developed by Karl Suess, Siemens, and the IMT, the researchers expect to achieve the required positional accuracy soon. ☐

News Briefs

Chip slowdown mirrored in Silicon Valley hiring slump

As business in the semiconductor industry continues to scrape along the bottom, executive hirings are feeling the effect. According to a survey by Korn/Ferry International, an executive recruiting agency, demand for senior executives in high technology is off from last year's record levels. The study notes that the semiconductor business is coming off a six-month decline in sales, with no upturn expected until sometime in the second or third quarter. "Until then, hiring will be slow and many dependent industries like capital-equipment manufacturers will be on hold as well," says Robert Lo Presto, managing partner of the firm's Palo Alto office. In the first quarter of this year, demand for senior managers stabilized at about the same level hit in the second half of 1984, but was less than 1984's first two recovery quarters. Chief executive officers and general managers, "those with profit-center responsibilities," are most in demand.

Datapoint hopes to become profitable after new layoffs

Asher B. Edelman, Datapoint Corp.'s new chairman, says more layoffs are in the offing at the troubled computer maker in San Antonio, Texas. Since the beginning of the year, Datapoint's worldwide work force has been cut from about 8,500 to under 7,000 through furloughs, sale of a subsidiary, and attrition. Edelman, however, expects further cost reductions to bring the company out of the red. Recently, he made a show of confidence by purchasing an ARC local-area network and five desktop work stations from Datapoint for use in the New York offices of his investment firm.

Brother Industries marries daisy wheel, dot matrix in new printer

Brother Industries Ltd. last week introduced a hybrid printer that integrates the best features of dot-matrix and daisy-wheel printers to produce composite documents. The Nagoya, Japan, firm mounted both a dot-matrix print head and a daisy wheel side by side in a single printer that has the precise control needed to have both heads work on separate parts of the same document. As a result, the dot-matrix head produces graphics while the daisy wheel prints letter-quality text and captions for graphs. Draft copies can be printed at 160 characters/s. In the letter-quality mode, characters not contained on the daisy wheel are printed in near-letter quality by a triple pass of the dot-matrix head. The firm claims the HR-35DD Twinriter 5 printer provides optimum printout of composite documents previously available only by using a laser printer costing at least twice as much. Moreover, the printer can replace the separate daisy and dot-matrix printers that are often placed side by side, thus saving cost and space. Sales in the U.S. will start in May; the printer will sell for $1,295.

Supreme Court to review TV dumping case

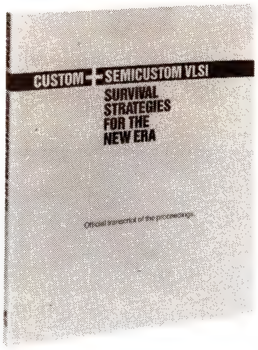
The U.S. Supreme Court will review an antitrust and antidumping suit brought by Zenith Electronics Corp. against major Japanese TV vendors. A Zenith representative says the firm is "confident the Supreme Court will reject the arguments of the Japanese defendants and will affirm the unanimous judgment of the Court of Appeals," which ruled that there was enough evidence for a full trial on the charges. Zenith alleges that the defendant firms conspired to dump TV receivers in the U.S. and to monopolize the business by injuring or destroying U.S. set makers.

Philips, Kyocera form joint venture

Philips of the Netherlands has formed a joint venture with Kyocera Corp. of Kyoto, Japan, to market Sopho-Net, Philips's packet-switched wide-area network, to customers in Japan. The venture, to be called Kyocera and Philips Data Communications Networks Corp., will be based in Tokyo and start operation later this month. Kyocera will provide the local management and software expertise needed to apply Sopho-Net in the Japanese market.

CUSTOM AND SEMICUSTOM VLSI:

Survival Strategies For The New Era



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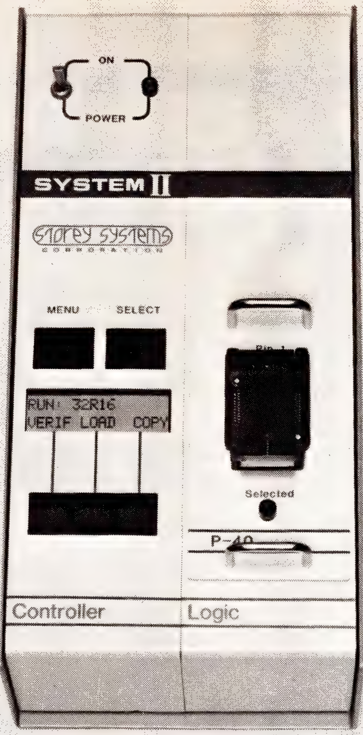

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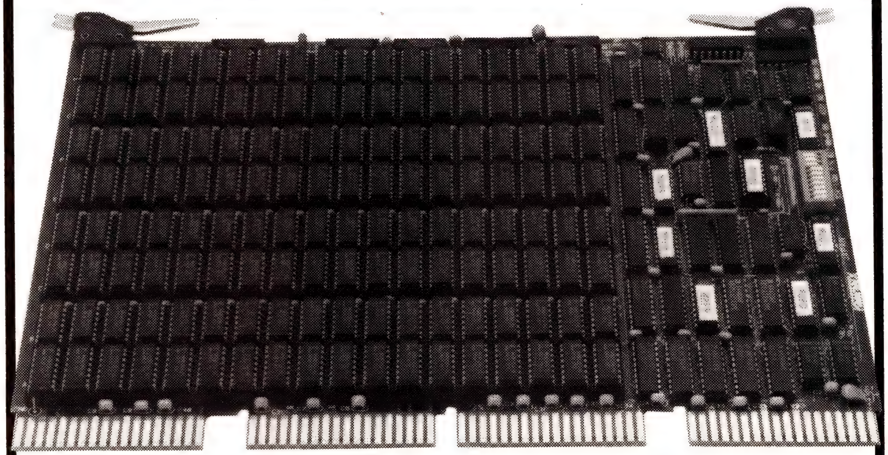

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THERE'S LIFE IN RESISTORS, GERMAN COMPANY FINDS

Heide, West Germany

At a time when the megabit memory and the computer on a chip provide all the drama in electronic components, passive devices such as resistors hardly seem to be the kind of actors to move into the limelight. But Beyschlag GmbH, a 400-person firm in this north German town, is challenging the assumption that the resistor is as passive a player as the class of devices to which it belongs.

If Beyschlag doesn't stand out by virtue of size and business volume—sales last year came to about $17 million—it excels in its growth rate and particularly as an innovator and trendsetter (see "Beyschlag's history is as unique as its wares," p. 39). Averaging 5% to 7%, its annual sales increases "have consistently been higher than the market average of 2% to 4%," says Helmut Düll who, as one of two managing directors, is responsible for engineering.

Pointing up the firm's technical ingenuity is a resistor so small that it fits under a fingernail. Designed as a surface-mountable device, when introduced last year it was the first metal-film mini-Melf (metal-electrode face-bonding) resistor combining a 0.22-Ω to 10-MΩ range with a temperature coefficient from 50 parts per million to as low as 15 ppm and a tolerance from 5% down to 0.1%.

Big push. With its MMA0204 mini-Melfs, Beyschlag wants to make a big push into the U.S. market, "aiming particularly at automobile and other rough-environment applications," points out Karl Mündl, managing director for commercial activities. The parts will be sold by Mepco-Electra Inc., a North American Philips company. Meanwhile, other resistor makers have jumped on the bandwagon with metal-film mini-Melfs boasting similar ratings.

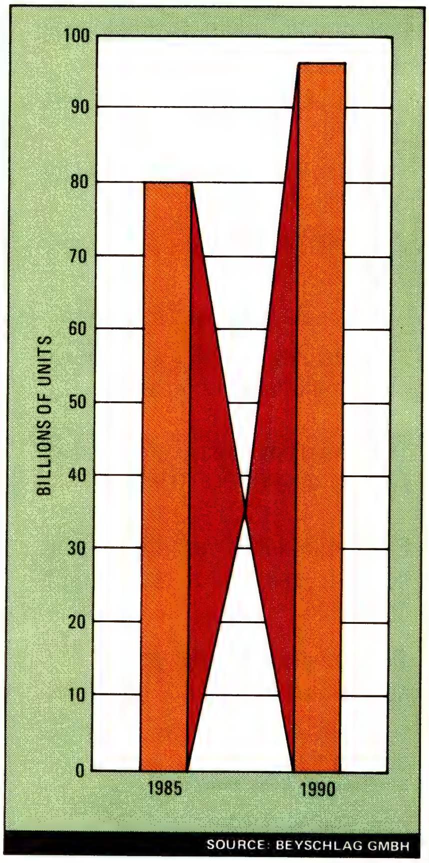
To support their claim of being a trendsetter, Beyschlag officials point to a number of product firsts their firm has scored. These include:

On top. Beyschlag's sales are above average, says managing director Helmut Düll (center), shown with fellow managing director Karl Mündl (right), and finance manager Walter Welter.

- Being the world's first company to put resistors on tape for automatic placement (1957).
- Introducing the type 0207 resistor for 0.3 W, the highest rating at the time (1962) for a resistor measuring only 2.4 by 6.3 mm.
- Introducing the Balox (for Beyschlag aluminum oxide) high-grade ceramic material (1979).
- Launching the Harmonic Series (1980), a family of three resistors that, with just one preferred tolerance of 0.1%, covers all applications up to 1 W.

Beyschlag operates in a market that, worldwide, increases by a rate of 2% to 4% a year. In this market, variable resistors are declining in value while fixed types are rising 4% to 5%, with film resistors leading the growth.

The German company pegs the world market for film resistors this year at 80 billion units and figures it will go to 96 billion by 1990. Among current film-resistor consumers, Japan, Western Europe, and the U.S. account for 27 billion, 20 billion, and 15 billion units, respectively; the rest of the world accounts



SOURCE: BEYSCHLAG GMBH

Irresistible. Beyschlag accounts for 2.5% of the 1985 world market for film resistors.

for 18 billion units. Three quarters of them are carbon-film types.

Beyschlag accounts for just 2 billion of the current film-resistor market, or 2.5% of the 1985 total. But instead of carbon-film versions, the company emphasizes the higher-quality metal-film resistors. These make up 85% of the firm's total production, with the Harmonic Series types by far the front-runners in terms of numbers.

Meeting demand. Beyschlag is expanding production capacity for mini-Melfs in anticipation of a big demand for SMDs. By 1990, this capacity may exceed 800 million units, by which time the mini-Melf output may be between 30% and 50% of the company's total, Mündl says. "With such devices, we are aiming for a substantial share of the market for SMD resistors for nonconsumer uses," he adds.

An important factor in the firm's success formula is the large amount it spends for research and development—between 10% and 12% of sales, which is common for the semiconductor industry but above average for the resistor industry, Düll claims. Much of this R&D effort goes into the development of production machines. About 100 people, or one quarter of the workforce, are engaged in machine design and construction.

As designers integrate more and more devices onto a chip, some people are predicting the gradual demise of the discrete resistor. But the opposite is taking place.

In practice, Düll says, the integrated circuit has broken ground for new resistor applications. "If 20 years ago a TV receiver used 350 discrete resistors, it has around 500 today because of the set's added features like remote control, videotex, and other functions—this despite the greater number of ICs it uses."

Simple though it may be, the resistor still provides much room for technical advances, and Beyschlag is working hard to keep ahead in the field. Among its development goals are still tighter tolerances—down to 0.01% from today's 0.1%—as may be required by high-precision test and measuring equipment.

Goal is reliability. Then there is the need for higher reliability as demanded by missile and spacecraft technology. Here, the goal is to have all resistors behave exactly as predicted. "If the level of reliability is now 1 ppm, we think it can be improved to 0.1 ppm," Düll declares.

The ultimate goal for Beyschlag is to keep the resistor as easy to work with as it is today, Düll says. "If equipment designers do not talk much about the good old resistor because it poses no problems, that's good. We want them to talk even less about it." **–John Gosch**

Beyschlag's history is as unique as its wares

Turning out unusual products seems natural for Beyschlag GmbH, itself the product of an unusual history. Founded in 1931 in Berlin by Bernhard Beyschlag, the company fled the advancing Russian armies at the end of World War II and moved west to set up production on a barge on the Elbe River, plugging its machines into land-based generators. "This was probably the first riverboat electronics production ever," says Günter Ortmann, international sales and marketing manager. Following the war, the firm operated temporarily out of a hotel and then settled on the island of Sylt in the North Sea, making resistors in former military barracks and drawing on the manpower provided by refugees on the island.

In 1964, the childless Bernhard Beyschlag sold out to Philips GmbH, the German unit of the Dutch electronics giant, to ensure his firm's continuity. But unlike other Philips affiliates, Beyschlag's relationship with is parent is at arm's length, says managing director Helmut Düll. "We steer a pretty independent course, competing head on with Philips on the resistor market." As the island of Sylt opened to tourism, Beyschlag gradually shifted production 60 miles south to Heide, a town on the mainland, completing the move in 1974. Since then, it has turned out some 35 billion resistors for consumer and industrial equipment. –J.G.

BOTTOM LINES

Engineer turnover in 1984 at 17%. The American Electronics Association, in its first look at the situation, found that the turnover rate for engineers in the electronics industry last year was 17%. Contrary to popular conceptions, electronics firms in the metropolitan New York area had the highest turnover rate among engineers—20.7%. This was followed by Washington state and northern California, with 20.1% each; Orange County, Calif., 19.3%; and New England, with 17.6%. According to the survey, Florida had the lowest turnover rate, at 11.9%. The next lowest was Oregon, at 12.1%, followed by Colorado, 13.1%, and Minnesota, at 13.5%.

Looking at the turnover rate by job type, the survey found that hardware engineers were more stable than software engineers. The turnover rate for the former was 15.2% versus 22.2% for software engineers. The AEA says that, in comparison with these rates, the total employee turnover rate in the electronics industry was 21.4% in 1983, the latest figure available.

Continental Telecom acquires NDS. Continental Telecom Inc. has agreed in principle to acquire Northern Data Systems Inc., a Bedford, N.H., developer of turnkey business computer systems. Under terms of the deal, Contel will pay $11 per share for all NDS stock owned by stockholders outside of NDS; inside stockholders will receive $7 a share for the NDS stock they own as well as future payments over the next three years, contingent upon the future performance of NDS. NDS has about 3.2 million shares outstanding, of which 950,000 are held by outside stockholders and the remainder by inside stockholders.

Proteon gets more venture capital. Proteon Inc., developer of the Pronet local-area network, raised $6.5 million in a second round of venture financing. The Natick, Mass., company says it will use the funds to expand its marketing activities and for research and development of new networking products, including its Pronet-10 and Pronet-80 local nets.

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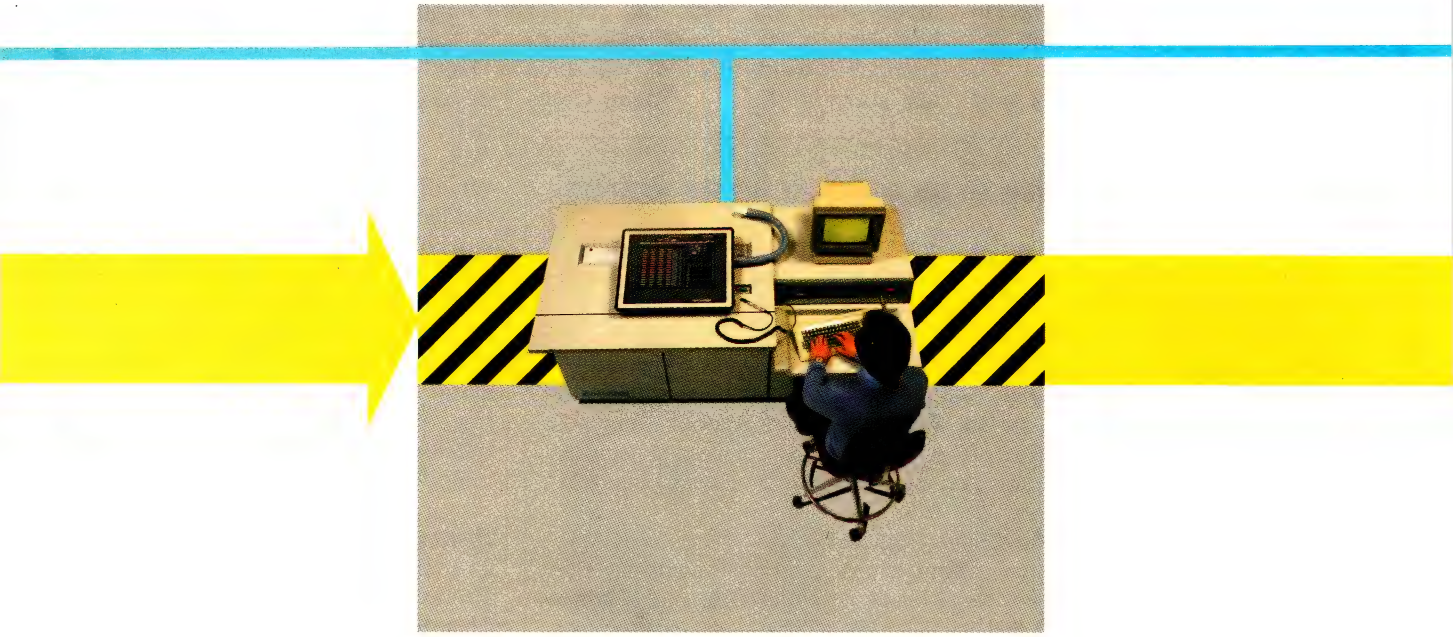

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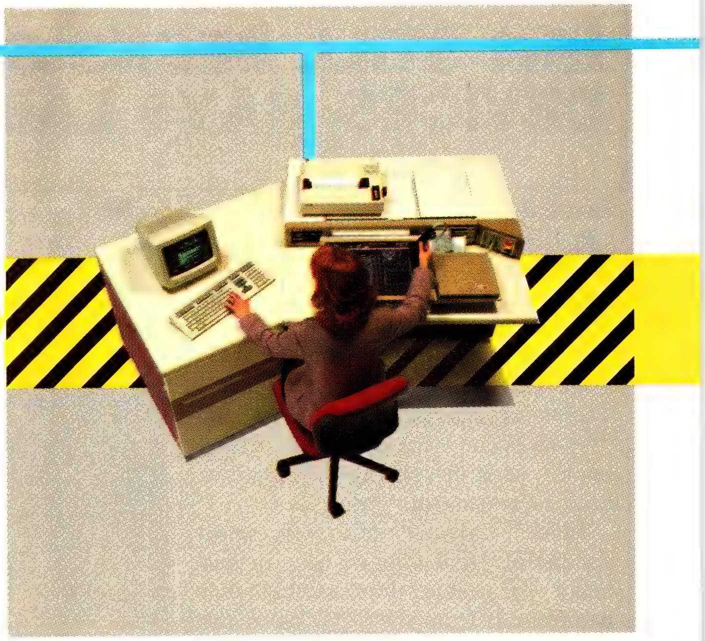

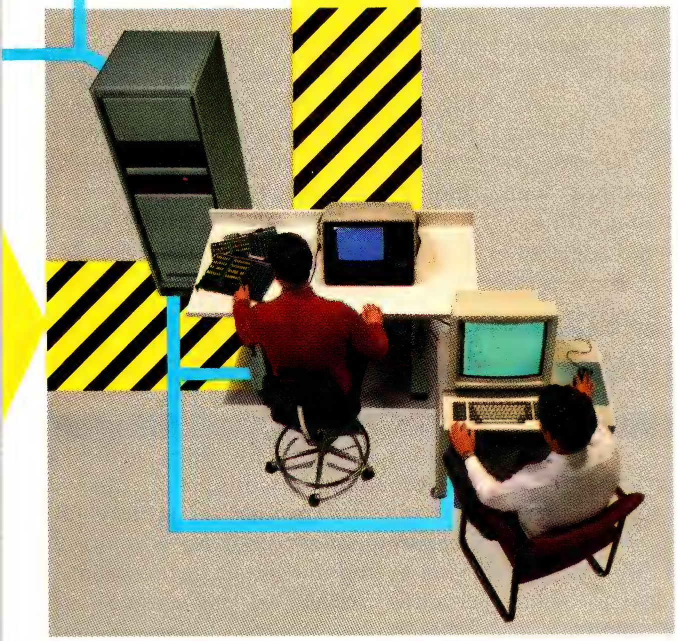

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IBM STILL SEEKS SMALLER, CHEAPER DEVICES, SAYS LAB DIRECTOR DONOFRIO

Essex Junction, Vt.

Although the prices of IBM Corp.'s high-performance systems have increased by about a 10% compound growth rate over the last 20 years, Nicholas M. Donofrio, laboratory director at IBM's General Technology Division here, maintains "we've been increasing our performance at a faster rate than we've been increasing our price."

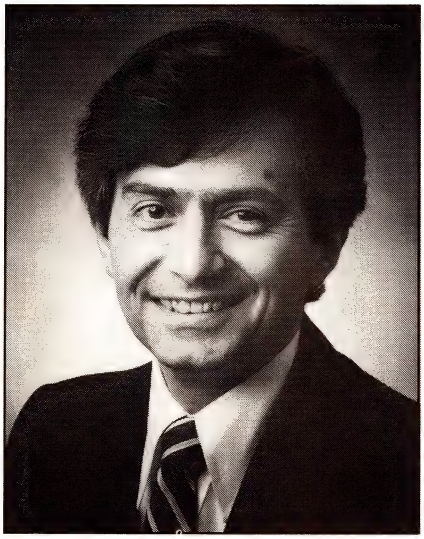
Indeed, says Donofrio, 39, semiconductor technology has driven down the cycle time of high-end mainframes from over 200 ns in the mid-1960s to about 20 ns for the 3081X, currently one of IBM's most powerful mainframes. And as smaller size allows more logic circuits to be crammed into computers, technology prices have been declining at about a 14% rate for high-end computers, Donofrio explains.

Although high-end systems were built using bipolar technology, the evolution of the engineering work station—a growing market for IBM—parallels the development of FET microprocessor technology.

Parallel career. Donofrio's career nicely parallels the development of semiconductor technology over the last 20 years. A native of Beacon, N.Y., he first came to IBM in 1964 as a Rensselaer Polytechnic Institute undergraduate student participating in a cooperative program. After graduating with a BSEE in 1967, he joined the IBM staff at Poughkeepsie as a junior engineer. Donofrio earned his master's degree from Syracuse University in 1971, and went on to develop FET memory circuits.

Despite the many changes he has seen in the past two decades, Donofrio says the goal remains simple: "All we're trying to do is continue to make things smaller so that we can make them cheaper." Since 1965, bipolar has been the dominant logic technology for midrange and high-end systems, he says. "We milked a lot out of [bipolar] technology. That technology went from one circuit per chip to over 1,000 circuits per chip and from 10 to 20 ns to 500 ps."

Memory technology, in contrast, "has had a very interesting and varied history in the same relatively short period of time," he asserts. This technology has changed four times in 20 years, beginning with ferrite cores and progressing to bipolar, FET static random-access memories, and today's dynamic RAMs. He estimates that this has resulted in an annual decline in price per kilobyte of about 27%.



Chipping away. Nicholas Donofrio's career with IBM Corp. spans 20 years of logic and memory technology development.

Since coming to Essex Junction, a suburb of Burlington, Vt., in 1972, Donofrio has served as a senior engineer and advanced memory component development manager. He was also influential in the development of SAMOS technology memory chips. Since July 1983, he has headed a staff of 2,000 that is developing IBM's megabit technology.

Donofrio says the incorporation of thermal-conduction modules into IBM's high-end 3080X and 3090 series [*ElectronicsWeek*, Feb. 18, 1985, p. 13], allows it "to pack those very high-performance and hot bipolar circuits very close to each other and continue to improve the cycle time."

Based on this history, Donofrio sees FET technology eventually migrating to novel structures like vertical device structures, while continuing to push lithographic techniques for bipolar to fabricate ever-shrinking transistor designs. He also thinks gallium arsenide is more readily applicable to FET-type structures than it is to bipolar. **–George Leopold**

STARTUP SPECIALIST VILLERS TACKLES COMPUTER-AIDED MECHANICAL ENGINEERING

Burlington, Mass.

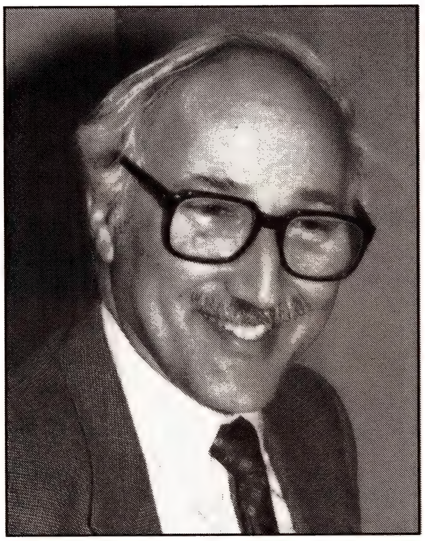
Philippe Villers, chairman of Automatix Inc., a robotics firm near here, was in a rut. "Being the full-time chairman of a company with 400 employees did not challenge me—it was not enough for me," he says.

When Villers finds himself in a rut, he has a history of starting up companies in emerging markets. He founded Computervision Corp. more than a decade ago and became a pioneer in computer-aided design and -manufacturing. Five years ago he started Automatix Inc., a company that is still struggling for a niche in industrial automation. So Villers is again eyeing uncharted turf: computer-aided mechanical engineering, or MCAE. In January, Villers, along with a dozen other veterans of high-tech industry, announced the startup of Cognition Inc.

Frontiersman. The origin of Villers' idea can be traced to the question Villers also asked himself before launching his other companies. "I thought about the expanding role of computer systems in industry [and asked], what's the new frontier for computer systems?"

Villers, 49, says the time has come for true MCAE because its technical requirements—megaword memories, sophisticated networking, and large virtual memory systems—are available at prices that engineers can afford.

Mechanical engineers "don't often work enough with single analytical techniques to master them, and the refamiliarization pain is too great," he says. "Ask the average mechanical engineer if he uses many of the analytical tools he would like to use to make a better product and he'll say no. We want to make it possible for engineers to come up with more optimized designs." Villers says such designs will become possible by taking those analytical tools off the bookshelf and offering them on the computer screen.



New turf. Philippe Villers, founder of Computervision and Automatix, now heads Cognition Inc., a new entry in the MCAE field.

$100 million target. Cognition's founders are in the process of raising $8 million to $10 million to launch the business. While refusing to speculate on the size of the MCAE market, Villers says, "The global objective will be to reach $100 million in sales in five years. We want to be the leader and we think it will take that kind of growth to be the leader."

Cognition plans to have a product ready for market about a year after raising capital. Intending to buy most of the hardware needed, the company will direct its efforts primarily in the area of software. And Villers is not daunted by the current softness in the capital equipment market. In fact, he says it's a plus for his venture: "With the right kind of track record, you can get started when others can't." **–Craig D. Rose**

EAST GERMANY'S HERZOG COMPETES WITH WEST FOR WORLD MARKETS

Leipzig, East Germany

When Hans-Eberhard Herzog talks about the challenges he faces, using such phrases as competitive in world markets, new breed, and latest trends, he sounds like an industry leader in the capitalist West. But in reality, Herzog manages an electronics group in socialist East Germany. As managing director, he heads VEB Kombinat Nachrichtenelektronik, which roughly translates to people-owned combine for communications electronics.

The organization, headquartered here, is a 39,000-worker nationwide combine with 17 manufacturing units and one research institute. It produces everything from analog and digital exchange systems to teletypewriters, radio gear, and telephones, and even includes selected consumer, studio, and medical electronic items. Last year, the combine made about $1 billion worth of sales.

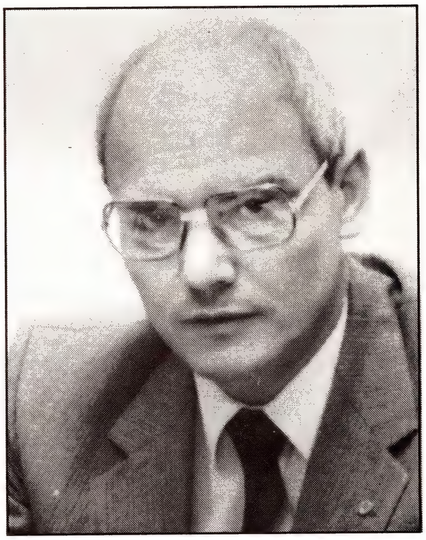
Herzog's prime challenge is to push the country's telecommunications sector into the digital era and to speed the application of microelectronic techniques, with the emphasis on digital circuits, including custom chips. This is intended not only to cope with the increasing amount of voice and data traffic at home by using up-to-date equipment, but, he says, "also to keep the sector competitive on world markets."

Technocrat. Herzog, 49, is typical of a new generation of managers who have come up through the ranks and have thorough, hands-on experience in their specialties—in contrast to the appointed bureaucrats of years past. Herzog started as an electrician, studied high-frequency engineering at the Technical University of Dresden, and finished with a master's degree.

After college, he started at the combine as a development engineer. Then he advanced to department manager and subsequently became a deputy to the Minister for Electrotechnology and Electronics in East Berlin, where his major responsibility was to promote microelectronics applications in communications. About three years ago, he became managing director of the combine.

One thing Herzog worries little about is keeping the Soviet Union a customer. About 30% of the combine's output last year was exported to the Soviet Union, with another 20% going to other socialist countries, to developing nations, and to the West. The remaining 50% was for the home market.

West won't sell. Herzog complains about Cocom (coordinating committee for East-West trade policy) regulations that forbid Western countries to sell advanced electronics equipment and components such as microprocessors to Eastern Bloc countries. But Herzog asserts that Cocom "has not prevented us from building high-quality communications gear that stands the test on Western markets." As proof, he points to Greece—"where we are competing with [West Germany's] Siemens at competitive prices." **–John Gosch**



Competitor. Hans-Eberhard Herzog wants East Germany's telecommunications sector to be competitive on world markets.

Canon Mirror Projection Mask Aligners for up to 6″ wafers

There is no advantage in utilizing larger diameter wafers with aligners that do not expose the entire usable area. The new Canon MPA-600FA is a state-of-the-art mirror projection mask aligner capable of handling up to 6″ wafers with *full coverage.* To meet existing production requirements as well as future needs, the MPA-600FA can also handle 4″ and 5″ wafers, and can be retrofit in the field.

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Circle 44 on reader service card

FIBER OPTICS TAKES OVER

Lower installation and maintenance costs and space-saving installation have set optical-fiber systems on a roll

☐ *by Terry Feldt*

Though optical-fiber systems first attracted designers with their potentially huge information-handling capabilities, they have yet to overtake the capabilities of coaxial systems. But what fiber has demonstrated, and what drives the trend toward future universal use of optical fibers in communications systems, is an ability to lower the cost of equipment-system installation in crowded ducts, maintenance, and upgrades—important factors that weight the scale in fiber's favor over systems based on coaxial and microwave technologies.

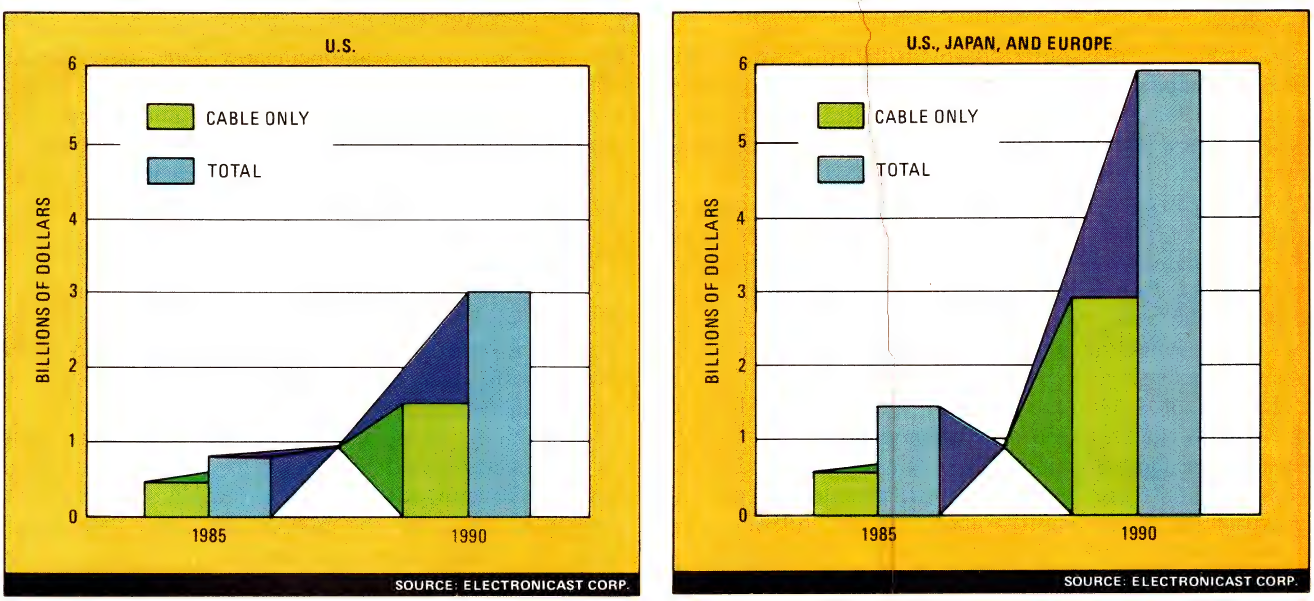
The movement from electrical to optical communications should grow in the next five years (Fig. 1). For example, SaskTel, the telephone company of Saskatchewan, Canada, inaugurated in March a 3,268-km system that forms the backbone of the telecommunications network linking the province's major communities.

Meanwhile, Nippon Telegraph & Telephone Public Corp. has started building a big fiber-based integrated communications system to serve all of Japan, called the Information Network System. Further developments that are in the experimental stages will bring fiber-optic communications even more into the limelight.

With fiber, it is possible to establish high-capacity links between distant points without expensive repeaters. The elimination of these remote underground repeaters has been the overriding key to optical fiber's economy.

Other factors that favor the use of fiber in communications include the fact that fibers provide immunity against electromagnetic interference as well as electrical isolation between stations. For many applications, such as internal communications in aircraft, using fiber saves significant weight and space.

Single-mode fiber is currently the premier technology, and systems are going into operation all over the world. The core of a single-mode fiber is small enough so that only one mode of light can propagate through. The low dispersion of single-mode systems is a boon to increasing throughput, extending repeater distances and reducing



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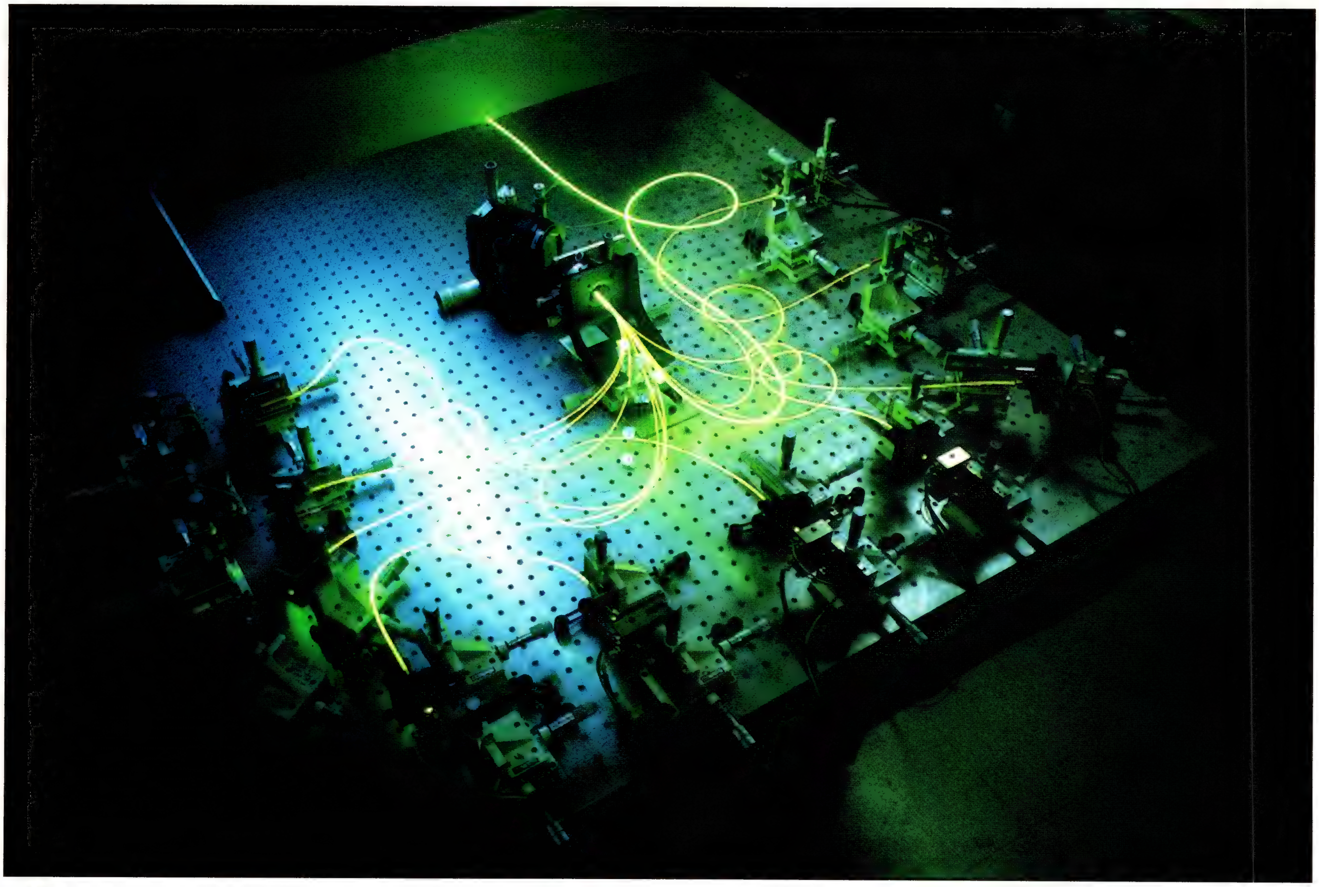
1. Up and away. In the next five years, the U.S. market for fiber cable should more than double, with more than a threefold increase when the supporting optical components are taken into account. The increase is even greater when Japan and Europe are included in the calculation.



2. Many into one. AT&T Bell Laboratories' multiplex system combines 10 adjacent laser beams into one single-mode optical fiber carrying data at 20 Gb/s for 68 km. The system uses distributed feedback lasers, a technology that may usher in more sophisticated systems.

costs. High bandwidth teamed with low loss characteristics have brought single-mode fiber to the forefront of long-haul fiber applications. Hence systems built with single-mode fiber have all but snuffed out the use of multimode systems in telecommunications.

At the 1,310-nm wavelength, today's fiber delivers under 0.5 dB/km of attenuation. This allows for repeater less links of over 30 km at data rates in the hundreds of megabits per second.

Over 80% of fiber-optic systems installed this year will be single-mode. The technology started its rapid emergence in 1983. Nonetheless, growth could level off somewhat as new applications and alternative fiber developments start coming into the picture.

Although telecommunications applications dominate today's fiber market, the upcoming surge of fiber-based LANs will bring more use of multimode and, possibly, plastic fiber. As the attenuation of plastic fiber is brought down to the level of tens of decibels per kilometer, interest in implementing plastic fiber in some LAN applications is increasing.

Dozens of LANs are now on the market. Most of these networks are based on multimode capability so that inexpensive light-emitting diodes can be used as drivers. (Laser sources are required in single-mode systems because of the strict coupling and connector tolerances in getting enough light power into the small core of a single-mode fiber). As a result of the upswing in fiber-based LANs, component manufacturers are now coming to consider the development of low-cost low-loss optical couplers to be an important technology area.

Coupling optical signals is important to long-haul communications, too. But in this case, coupling signals at different wavelengths into a fiber allows for carrying multiple channels. Laboratory work is aiming at increasing the information-handling capacity of a single fiber from 4 channels to 10.

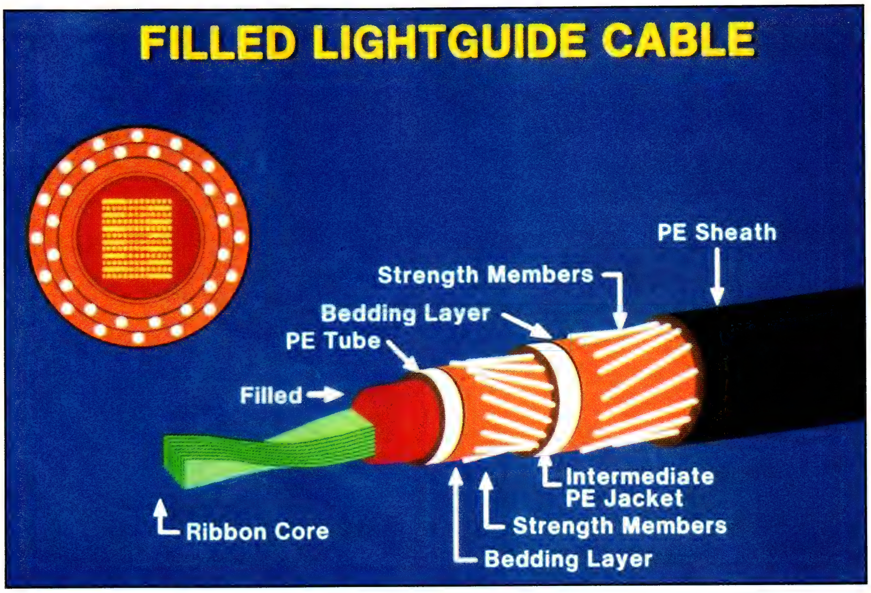
The capacity of individual channels is also expanding rapidly. Over the last five years, bit rates have jumped from 6 to 565 Mb/s; equipment now under development will allow for channel capacities in the range of 1 to 2 Gb/s. The increase in the number of channels that each fiber can accommodate, together with the higher capacity of each channel, is leading to a quantum jump in fiber's information-handling capability.

Unlimited capacity

"The future capacity is going to be virtually unlimited," says Jeff D. Montgomery, chairman of Electronicast Corp. He forecasts an order of magnitude drop in transmission costs over the next decade—services such as voice, data, facsimile, and video will all be affected.

When this happens, optical fiber will be used to build new architectures and topologies for moving very large digital bit streams containing text, graphics, speech, and video information in the integrated-system digital networks. Now most fiber installations are higher-capacity replacements for the copper-wire plant in parts of telecommunications systems. The network's topology usually doesn't have to be changed to take advantage of the fiber's greatly increased bandwidth over the copper cables that are being replaced. But replacing copper cables is not fiber's future. Instead, the benefits of fiber systems will come from a host of alternative large-area topologies.

Production of components for wave-division multiplexing and for optical coupling is crucial in allowing fiber to reach its full potential, however. Light sources will have to be capable of a narrow spectral bandwidth, without undesirable variations in frequency (or chirp) for the duration of a transmitted pulse. The development of lasers with these capabilities is at the research stage. On the other hand, optical couplers that can siphon off as well as combine pulses of different wavelengths have begun to appear on the market.



3. Packing them in. In the ribbon-core cable that AT&T calls a filled lightguide cable, 12 ribbons, each containing 12 optical fibers between adhesive-backed polyester tapes, pack 144 fibers surrounded by a water-blocking compound and a steel-reinforced outside sheath.

Couplers are important components for multiplexing—they provide optical systems with the function that T-couplers provide in electrical systems. With wavelength-dependent coupling, it is also possible to provide for duplex communications on a single fiber.

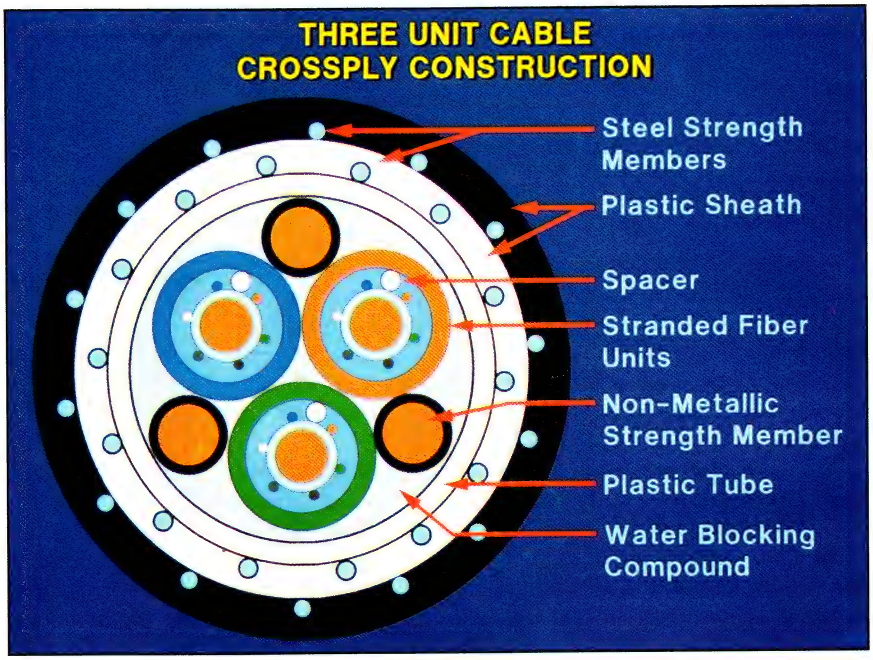
Early optical couplers—etched couplers—were fragile, with coupling losses that degraded over short periods of time, and this technology did not advance past the experimental stage. Polished couplers, too, ran into trouble, mostly because of the intricate fixturing needed to set and maintain the coupling ratio.

Now, however, fusion techniques can be used for fabricating low-loss, environmentally stable couplers. The Defense Electronics Division of Gould Inc., Glen Burnie, Md., makes couplers for multiplexing and demultiplexing in the 1,300- and 1,550-nm regions. The part's specifications include an excess loss of under 0.5 dB, with a minimum wavelength isolation of –16 dB. The package is 4 by 0.4 cm.

Early this year, researchers at AT&T Bell Laboratories demonstrated a fiber-optic multiplexing system (Fig. 2) with 20 Gb/s of capacity over a distance of 68 km. Optical multiplexers and demultiplexers combined and separated the adjacent beams of 10 lasers, each operating near 1,550 nm but at intervals of 1.35 μm. Each laser was then modulated with a word generator to simulate a realistic channel loading; the remaining lasers in the adjacent channels were modulated with a steady bit stream. Losses between 2 and 3 dB were reported for both the multiplexing and demultiplexing processes.

The setup used distributed feedback lasers, in which the continuous coherent backscattering, rather than end reflectors, provide the feedback. This technology is receiving more and more attention because the devices may usher in sophisticated systems, in the respect that modern radio systems are sophisticated. Current optical communications are sometimes compared with early radio telegraphy, when a broadband noise source was simply turned on and off.

The broad spectral bandwith of today's optical sources, and the chirp they exhibit as the devices heat up during pulses, results in a dispersive effect as the pulses travel down the waveguide. Different wavelengths propagate at different speeds. Thus bandwidth-distance products help



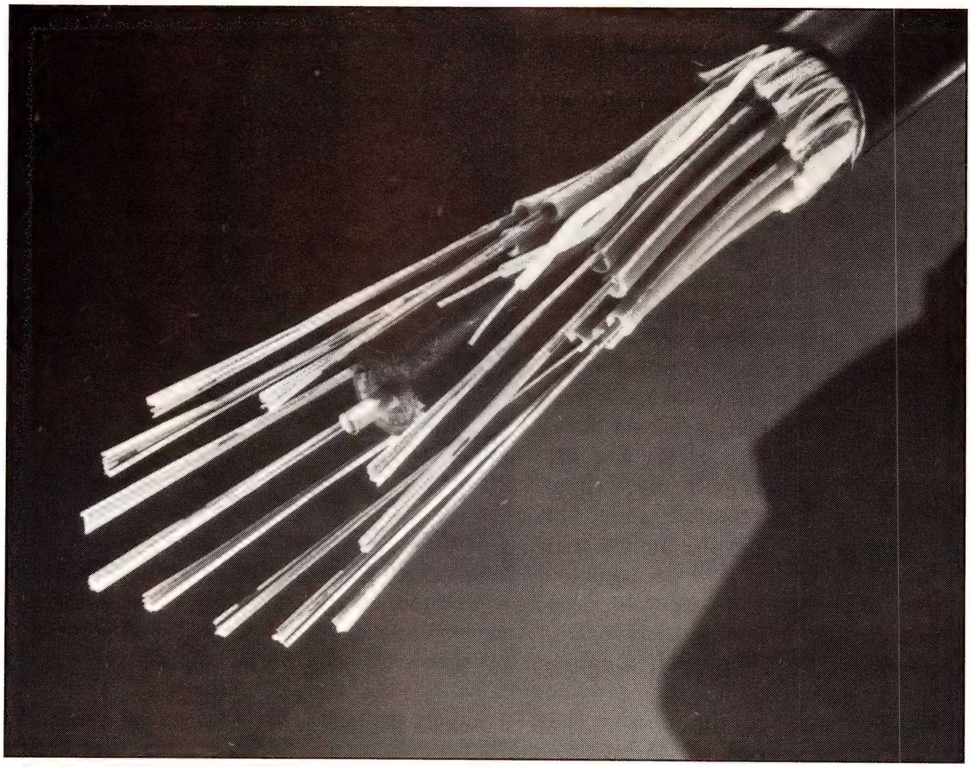
4. Another way. A stranded-fiber cable assembly can carry from 4 to 96 fibers. The cable holds one, three, or six stranded-fiber units. In turn, each stranded-fiber unit can carry from 4 to 16 fibers surrounded by a soft filling material.

in specifying a particular system's capacity.

Bandwidth distances vary greatly among system designs—higher than 10 Gb/km bandwidth distances are attainable in operational systems, while experimental systems have hit 468 Gb/km [*ElectronicsWeek,* Feb. 18, 1985, p. 37].

Conventional lasers exhibit an instantaneous spectral bandwidth tens of angstroms wide and a chirp also in the tens of angstroms. Reducing these characteristics to levels that are being achieved in laboratory systems will greatly mitigate the effects of dispersion. Then the trade-off between data rate and repeater distance will go away. Repeater spacing might extend to 100 km, independent of the data rate.

The latest record for information transmission over an optical fiber using a single laser beam was set recently by Bell Labs researchers. The results, announced last month at the Optical Fiber Communications conference in San Diego, from two different techniques were transmission rates in both cases of 4 Gb/s through more than 100 km without repeaters.



5. 132, count 'em. The Siecor single-mode fiber cable carries 132 fibers in a loose buffer-tube design. The cable has 11 buffer tubes, each of which has 12 fibers and one twisted pair of copper wires. This may be the biggest cable currently in commercial use.

The two techniques that were used were direct modulation and external modulation. In direct modulation, the laser is turned on and off directly, while in external modulation, a separate optical switch imposes a 4 Gb/s signal onto a steady laser beam. Although these experiments were conducted with special equipment in a laboratory, they demonstrate the potential for fiber systems with capacities that are 10 times greater than today's commercial systems.

Fluoride-based fiber

Another technology under development is fluoride-based fiber. The very low attenuation projected for this medium could lead to optical communications links with no repeaters, except for accommodating drop-offs. Leading fiber producers working in this area are Corning Glass Works and AT&T Co. Another important researcher in this field is Spectran Corp.

Though the capabilities of tomorrow's optical technology challenge the imagination, fiber-cable manufacturers also have the task of packaging today's silica fiber in innovative cabling schemes that fully exploit one of fiber's more important advantages—its small size. In the same space, an order of magnitude more capacity can be accommodated with fiber than with coaxial cable. Hence fiber is a natural choice when cables need to navigate crowded conduits and tight corners.

Cable design is critical for making the most of the space advantages in a fiber-based system—fiber's inherent low loss can be degraded by lighting strikes and rodents, as well as manufacturing and installation hazards. The emergence of fiber has brought with it the need for the development of new cabling methods.

AT&T Bell Labs' Norcross, Ga., facility has advanced the state of the art in ribbon-based and stranded cables to meet the stringent requirements of long-haul applications. The cables support wavelengthes of 1,310 and 1,550 nm.

For ribbon-based cable, 12 ribbons—each of which contains 12 fibers between adhesive-backed polyester tapes—are stacked to form a rectangular array (Fig. 3). The array is covered with a water-blocking compound, and the outside of the cable consists of a steel-reinforced sheath.

Supportive cable

Stranded-fiber cable can support 4 to 96 fibers per cable (Fig. 4). The cables contain either one, three, or six stranded-fiber units. In turn, each unit holds between 4 and 16 fibers imbedded within a soft filling compound, which prevents bending of the glass fiber. All fiber units are surrounded by a water-blocking compound. A strengthening member runs down the unit's center; different types of outer sheaths are used in different environments.

The march for more capacity in less space is unrelenting in the fiber-cable industry. Last month, for example, Siecor Corp. announced the delivery of a single-mode cable with 132 fibers to Southwestern Bell for a network in San Antonio, Texas (Fig. 5). The cable consists of 11 buffer tubes, each containing 12 optical fibers. ☐

MODULES CUT ATE COSTS

For low-volume production, field service, and production rework, flexible ATE outperforms dedicated systems at lower cost

by *Robert Adams*

For manufacturers of semiconductors and large electronics systems, dedicated automatic test equipment is a necessary—albeit hefty—investment. But for thousands of small systems and subsystems manufacturers, the high cost of in-circuit functional ATE testers—which can range to well above $100,000—puts such systems out of reach. These companies instead rely on manual testing.

There is an economical ATE alternative, however. Flexible ATE can be used for such test applications as field service, low-volume production test and rework, depot maintenance, and engineering design.

Large test systems—such as a bare-board or loaded-board in-circuit tester complete with large computing engines, many bays of equipment, and price tags of more than $100,000—include functional testing and require dedicated software. These systems are generally meant for testing and incoming inspection in high-volume production, which makes an expensive dedicated system feasible because the potential exists for significant payback.

A flexible ATE system (Fig. 1) usually consists of off-the-shelf instruments joined by an IEEE-488 or RS-232 bus to relieve the incompatibility problem that can occur in linking parts from different vendors. Its major advantage is that it can easily be reconfigured for a variety of test applications: the user can swap instruments as hardware needs change for different applications.

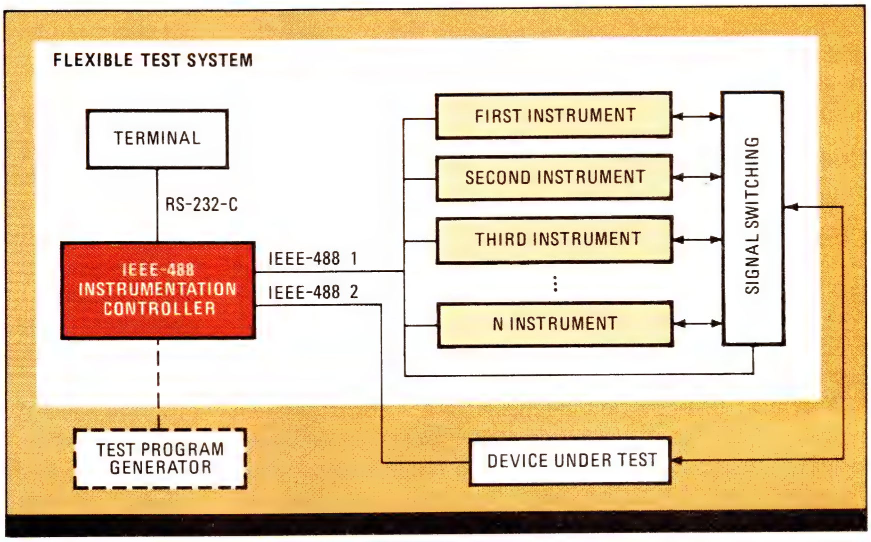
Often, the system can be maintained when a failure occurs by simply removing one faulty instrument for repair or calibration. Alternatively, the system can operate on limited capacity. In contrast, a failure in a large dedicated ATE system could shut it down completely until the vendor's factory service team can make the repair.

Because of flexible ATE's modular arrangement, it is possible to get the best performance from the system at the lowest cost by selecting the best price-performance instruments. The user can add or substitute better or less expensive instruments as they become available.

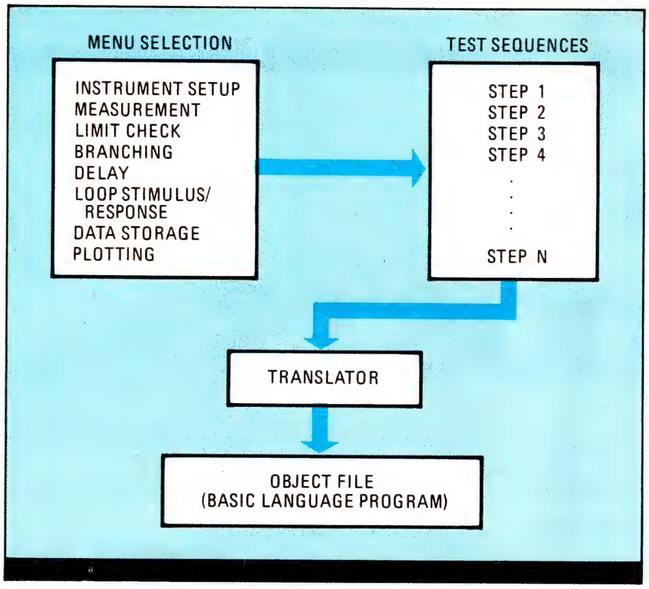
Flexible ATE is generally fully programmable for applications where testing is to be done with no operator intervention. Nonetheless, its components should also allow for operator intervention or manual operation when the situation so dictates.

For example, manual operation is desirable when an instrument has to function off-line for maintenance or troubleshooting purposes, for minor testing tasks, or for writing and debugging the system test program. Manual operation should be simple; it is frustrating for a technician to go off-line with an instrument and need an operator's manual just to understand the functions of the front-panel controls.

System components should be relatively small, light, and low in power consumption. This is so the system can



1. Mix and match. A flexible automatic-test-equipment system includes a variety of relatively low-cost off-the-shelf instruments, generally built by different vendors and tied together with IEEE-488 buses. A major advantage is ease of reconfigurability to handle varied applications.



2. Test-program generator. A menu-driven selection guide on a test-program generator makes it easy for a novice programmer to reconfigure test procedures and receive an object-code output.

be used in a variety of situations such as field service, where large ATE systems are not feasible. Although such a flexible test system could be called portable, it will rarely be compact enough so that it can be picked up with one hand. But the system should be fairly easy to move from site to site.

A flexible ATE system must be easy to use, easy to learn, and easy to program. Aids in learning the system components should include familiar arrangements of front-panel controls as well as firmware for front-panel setups. The instruments should be simple to program through an English-like command structure (such as the IEEE-728's 1982 Recommended Practice for Code and Format Conventions).

The command set should simulate the instrument's real functions so the operator doesn't have to learn a new language set. System components should be flexible enough to handle the IEEE-488 implementations of different manufacturers; end of message delimiters, serial-poll capability, and service-request features should be changeable so components can be quickly and easily integrated into the ATE system.

Reconfigurable testing

The concept of a flexible ATE system implies reconfigurability for new requirements as new test applications arise. Because writing software can be the largest single task in such a reconfiguration, and because software often makes up 90% of the cost of a system, a test-program language or test-program generator is highly desirable.

A typical test-program language is a software system running on a large computer that accepts special test-program language elements and produces a test program in object code. These language elements often read like English so that the entry program looks like a written test procedure.

A typical test-program generator is a menu-driven selection guide for entering the required test procedure (Fig. 2). The output of the test-program generator is a test program in object code or in an executable Basic language; the latter is ideal for writing and rewriting test programs because the users don't need to know any computer language.

The dividing line between large dedicated ATE testers and flexible ATE is neither clear nor precise. In many instances, either type of ATE system could be employed. A number of applications, however, seem better suited to an easy-to-use, reconfigurable automatic test system. For example, the manufacturer with low-volume production runs, for whom a full-scale dedicated ATE system would not be a wise choice, could put together a flexible system for well under $100,000.

Because such a system can be reconfigured, it makes sense not only for low-volume runs of one product but also for low-volume runs of a variety of products. A manufacturer of uninterruptible power supplies may produce many models of these supplies but not large quantities of any one particular type. A system that can be readily reprogrammed for a variety of products is an advantage to this manufacturer. Another company might have an incoming-inspection requirement for a large number of different parts and components. Again, the situation calls for a system that can be adapted quickly to test the variety of parts coming in each day.

Test power

One of the decided advantages of flexible ATE, especially for field service, is maximum testing power in a small package. Field testing takes many forms—from depot-maintenance facilities to portable on-site testers. In all cases, size and weight are paramount considerations, and any tester that can provide powerful testing capabilities in a small package is desirable. Present-day high-technology products are complex, difficult to service, and expensive to return to the factory for repair, refurbishing, or maintenance. Flexible ATE keeps such costs down.

At times, testing requires either that the operator intervene or that the ATE change modes of operation, from automatic to semiautomatic. Sometimes, measurements can be made only through external steps with results entered manually; at other times, the equipment must be used manually for a test. Environmental constraints could require manual intervention. Or perhaps some long-term effects that need to be measured require the ATE to change from manual to semiautomatic to fully automatic operation. Flexible ATE also provides for easy changes of operating modes.

Often, a company doesn't need to spend large amounts for a large ATE system, because flexible ATE can produce the same or comparable results at a fraction of the cost—but probably at a slower speed. A good flexible ATE system comes with a test-program generator, so that people with little or no ATE experience can learn to program their ATE quickly and easily. If the company's production volume rises, it can then consider a full-blown ATE system.

One reason that flexible ATE makes good sense is that it is a mix-and-match system. Many of today's sophisticated measurement instruments can be put together to create a flexible ATE system for much less than the price of a large dedicated tester. These individual instruments

3. Typical installation. When ATE is used in a modular configuration, multiple instruments are plugged into a power-supply mainframe and interconnected through an IEEE-488 bus.

often perform at higher levels than the components of a large ATE system. For example, a flexible ATE system can include sophisticated spectrum analyzers and state-of-the-art, very high-speed analog-to-digital converters.

Almost any area of a manufacturing company can use flexible ATE. Engineering design and evaluation departments have requirements for testing that change as new designs evolve. Incoming inspection is another good application for flexible ATE. Many companies have a large variety of low-volume items to inspect and test, arriving in staggered deliveries.

Because it is difficult and expensive to return faulty subsystems to the factory for repair and maintenance, portable testers for on-site troubleshooting are in demand. Many production facilities have production rework areas where test engineers and technicians troubleshoot and fix assemblies that have been deemed defective by a production test but are too valuable to be thrown away. Depot maintenance can also benefit from flexible ATE. This application usually requires an ATE system that can handle a variety of service functions, such as performance verification, troubleshooting using guided probes, or even manual testing for some especially troublesome problems.

Cost-effective conversion

Field-service teams must often bring equipment to a customer's site to perform maintenance or service and visit several different customers a day. It is cost effective to be able to convert from one test program setup to another quickly and easily. One aspect of field-service testing that is gaining recognition is the ability to take the data-acquisition instruments of a flexible ATE system to the site and then send data, through phone lines, to factory service personnel, who can make analysis and repair recommendations.

Instruments for flexible ATE should be modular in their configuration; ideally, there would be a power-supply mainframe into which multiple instruments can be plugged (Fig. 3). One power cord and an IEEE-488 bus for each mainframe keeps cabling simple. Each instrument module can then be changed easily from the front panel for reconfiguring to perform another test or to replace an instrument needing repair.

A universal command set offers the advantage of easy-to-understand English mnemonics. The commands are descriptive abbreviations of instrument functions and are universal from instrument to instrument where common functions exist. Items such as EOI (End or Identify), status bytes, queries, and data conventions will be consistent throughout the instrument line. Also, instrument messages and data formats will be the same from instrument to instrument.

This type of consistent and universal language set for instruments is becoming increasingly important. Typical commands for a power supply are VPOS 10, VNEG 12; commands for a counter, FREQ A and PERIOD A; and commands for a digital multimeter, ACV 1, DCV 0.2.

A learn-mode function makes it easy for beginners to learn instrument commands or functions. For example, with a single query, "SET?", the instrument will pass all setup commands to a host computer for storage and subsequent rerouting to the instrument. This learning function also simplifies the use of a software test-program generator.

Measurement control

Because instruments should perform both manual and fully programmable operations, their front panels should have the complete command set listed. In addition, the labels for the manual switches and knobs should describe the actual programmable command for that function.

Various methods of measurement control should be included as well. Often measurements will be made on the fly, meaning that the instrument is continuously taking readings and supplying the host computer with the most current reading upon demand. Other times, it will be necessary to synchronize several instruments to take a measurement. Then the use of the IEEE-488 function GET (group execute trigger) is useful and should be included in an instrument's characteristics.

Finally, some measurements—for example, counting a long series of pulses—may take a lot of time. This requires OPC (operation complete), to inform a computer when the measurement is completed.

It is a distinct advantage to have the instruments with as much computing capability as practical to ease the instrument controller's computational burden. Such capabilities as decibel conversion in a digital multimeter, rise-time calculation in a universal counter, or averaging and enveloping in a digital storage oscilloscope are examples of smart instrument functions. ☐

Robert Adams is a senior applications engineer with Tektronix Inc., San Diego.

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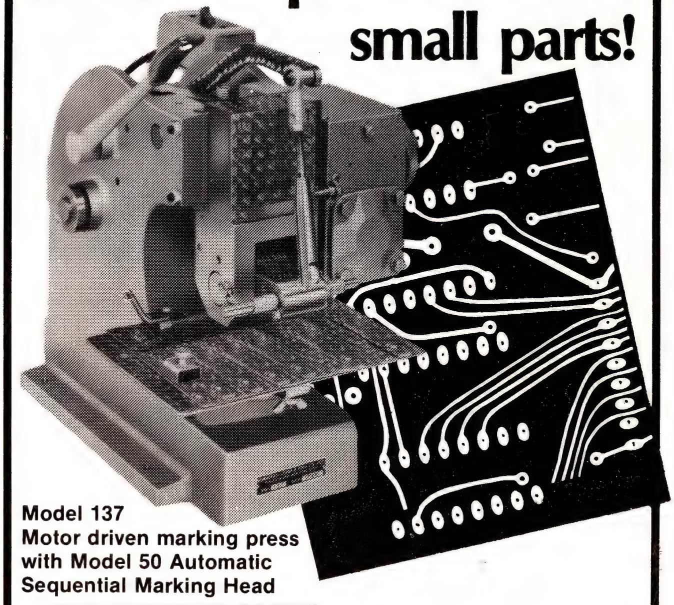

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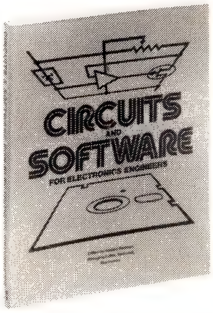

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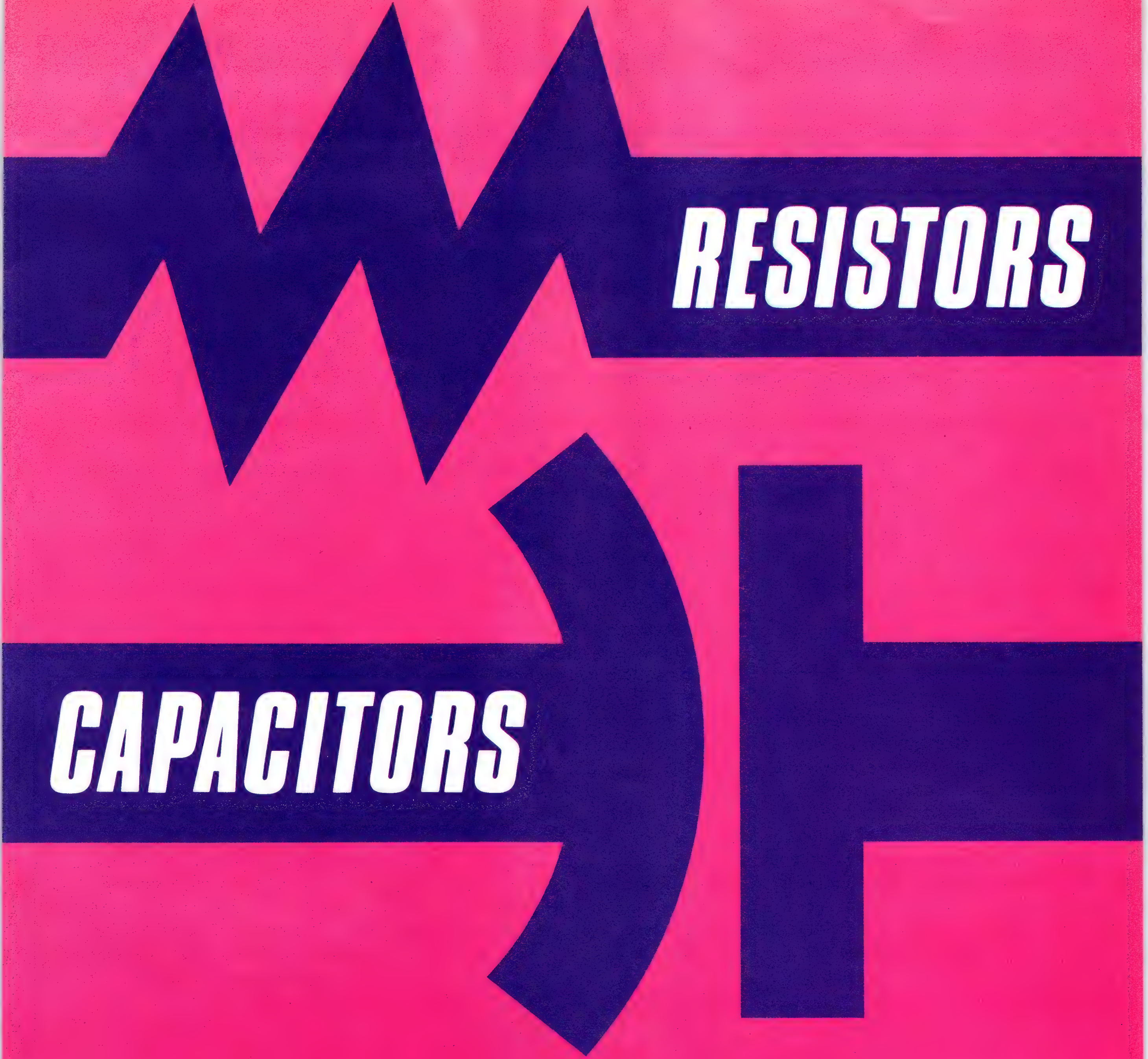

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A confluence of factors have combined to force fundamental changes in the way customers, distributors, and manufacturers do business

The revolutionary winds which have swept the electronics industry have blown less fierce on passive components, but this is not to say that the industry has been left unruffled. In fact, this middle of the 1980 decade is a watershed for designers, manufacturers, original-equipment manufacturers, and distributors.

New technologies have taken hold and are beginning to mature, and changes in the marketplace are forcing fundamental alterations in the way components are specified, marketed, and purchased. Foreign competition, automatic placement, space restrictions, surface mount technology, film networks—each alone would pose a challenge to established business practice; their confluence in 1985 means those involved in the once staid and steady resistor and capacitor business are due for some heavy rethinking.

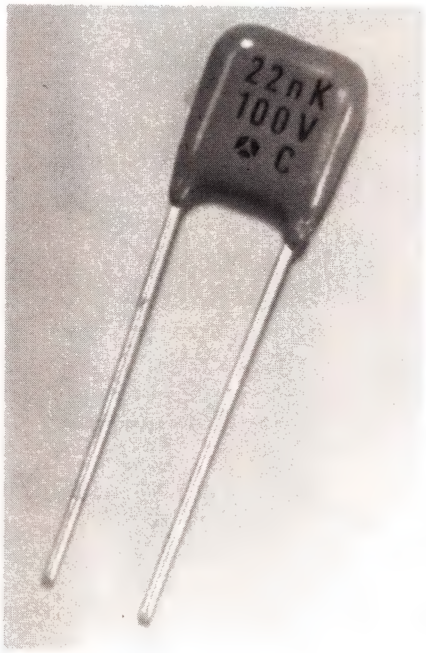
First, where we are

To get a better idea of what is being bought, bear with some statistics for a paragraph. The OEM consumption of capacitors in 1984, according to market research firm Gnostic Concepts, Inc., was $2,159 million. Of this, ceramics accounted for 35% of the total; paper and film, 24%, tantalum, 18%, aluminum, 13%, and other technolgies, 9%. This year, market growth is expected to reach 10%, with sales amounting to $2,336 million. The percentage breakdown of technologies will be approximately unchanged. By the end of the decade, sales are expected to reach $3,182 million—with some shifting of the technologies being bought: ceramics increasing to 39% of the total market; aluminium, 16%; tantalum decreasing to 13%, and other technologies almost unchanged at 8%.

The capacitor market breaks down into two segments—the general-purpose or commodity market, and the custom or dedicated products market.

The hottest news in the general-purpose sector is the move to surface mountable components, the result of a combined "technology push" and "market pull," according to A.D. Atkinson, market research department, Capacitor Division, STC Components Ltd. By this he means that the inherent advantages of surface mountable components is a potent draw, especially combined with the tug of foreseeable competition. Many manufacturers—particularly in the Far East—are making heavy investment in "onsertion" machines designed for very-high speed placement of components.

Space-saver. The Ecocap series just introduced by Thomson-CSF is an example of the high volumetric efficiency of dipped monolithic ceramic capacitors. [Circle 400]



Japan already surface mounts almost half of its components, compared to the paltry 6% in the U.S. Market reseachers estimate that, by 1990, between 1/3 and ½ of the total commodity market for capacitors will be for surface mountable devices.

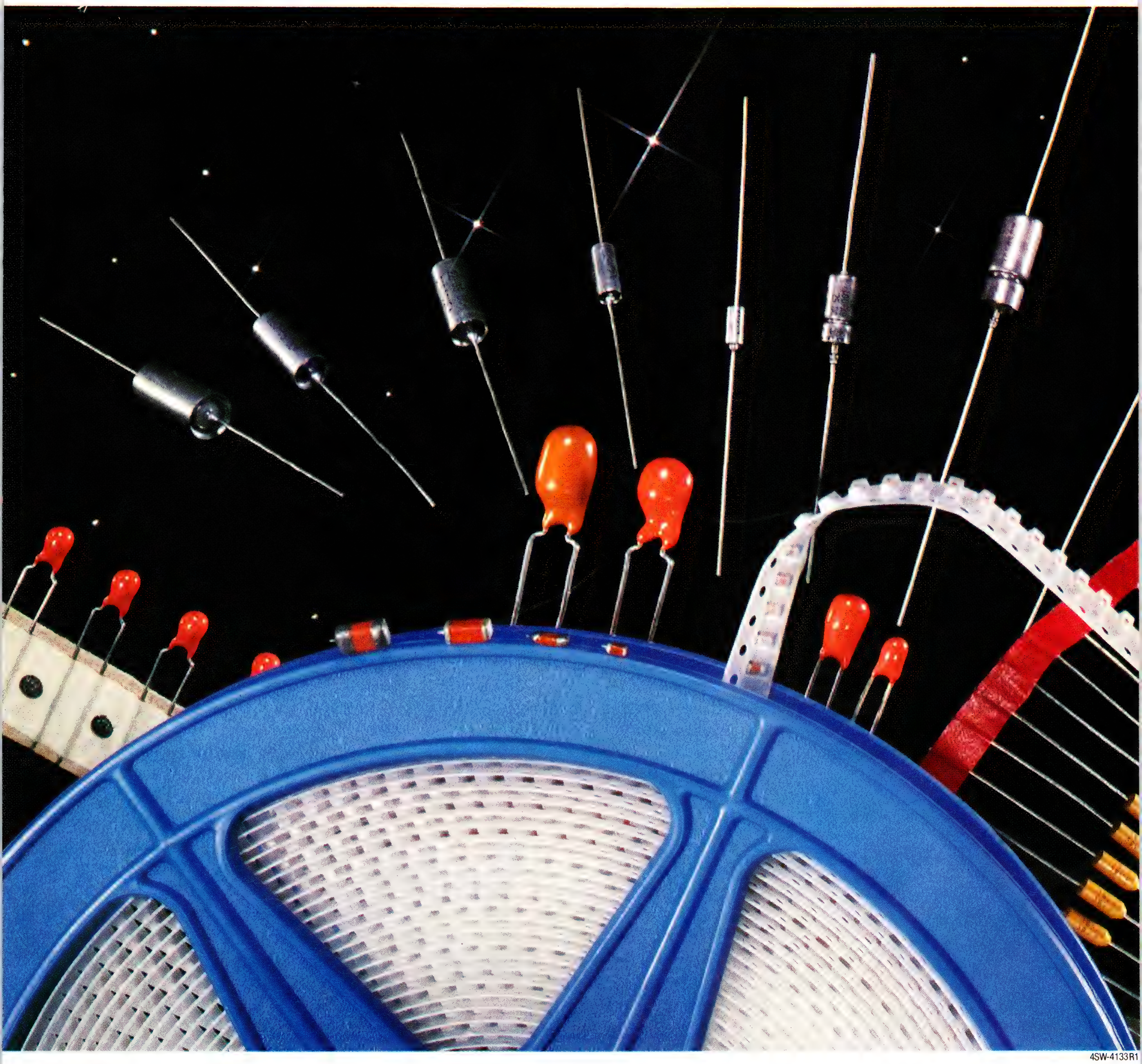
The good news, for the OEM customer, is that competitive pressure on suppliers will keep prices down and production activity high. Even now, surface mountable chip prices are becoming competitive with the average selling prices of equivalent leaded devices and, in a year or two, they will probably be lower—in some cases, significanty lower.

Business may also be simpler. Use of expensive automated-placement equipment, and the advantages of surface mountable components, will probably prompt the OEM to standardize his capacitor specifications throughout his product line rather than buy against each particular project.

To manufacturers, this is not the best of news. It means a difficult haul to maintain profits and prices—and this means maintaining large-quantity shipments or tying smaller quantities to a distributor source. (Those companies who depend heavily on the military are generally immune to this, but neither will they experience the exhilarating growth potential in moving into an entirely new technology sector.)

For distributors, growth of the surface mountable market will mean a

GLOBAL.



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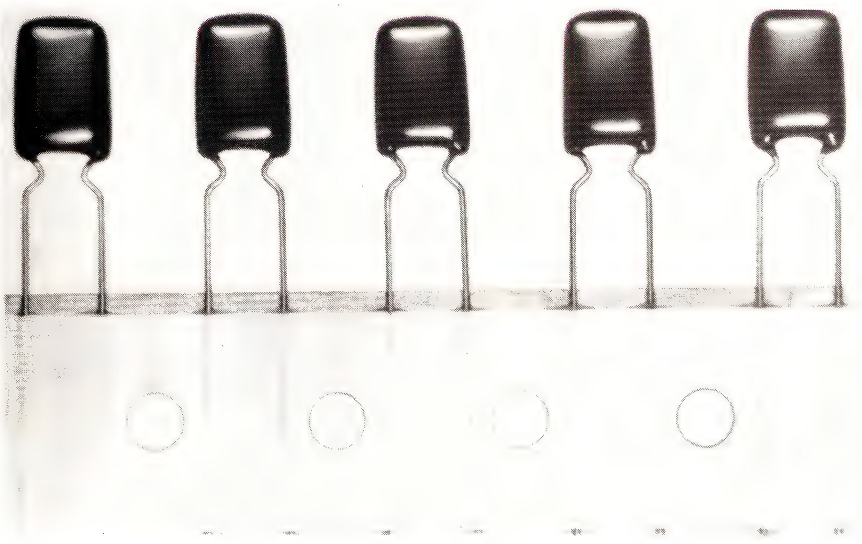
Circle 55 on reader service card



Stacked. Panasonic's family of stacked metallized film capacitors were designed to replace monolithic ceramic capacitors and are made without precious metals. [Circle 401]

tough fight to maintain a competitive edge. It is axiomatic to say that they will have to keep prices at the bare bones minimum, but to make things a little more difficult, distributors will also have to provide additional user services—such as applications support—and keep the cupboard full of product to cope with closer lead times.

All of this portends fundamental changes in the relationship among the OEM, manufacturer, and distributor, says Atkinson. As product prices decline, sales costs will increase and the high-cost, direct-sales manufacturers' representatives will be replaced by the distributors' sales representatives. "Distributors will be required to provide much greater flexibility in their service to manufacturers in order to offer a quicker reaction to market requirements," he says.

Changing roles

"There will be an even more rapid increase in the trend towards the manufacturers' product sales engineers changing their role—becoming sales managers for local distributors rather than being just product 'hawkers.' They, and the manufacturers, will have to provide more general suppoort, sales training, and product applications training for their distribution sales force. In addition, the manufacturers' sales engineers will also be called upon to 'design-in' commodity products with the OEM and to be a market intelligence gatherer from all sources so that the capacitor manufacturer can be made aware of the changes in equipment design and reflect these in new component innovations."

Shrunk. Ultraminiaturized aluminum electrolytic capacitors from Panasonic are the same size as a ¼-W resistor, so they can be inserted with automatic equipment. [Circle 402]

The custom capacitor market, although much smaller than the commodity, is nevertheless an important testing ground for newer technologies and designs. The major technologies involved in custom work are paper/plastic, dry solid tantalum, and wet tantalum.

Here, says Atkinson, the optimum performance of an OEM's equipment can come only when there is a total interface between the manufacturer and user. The customer/designer must look at the total application and be prepared to specify exactly what he wants within the current state-of-the-art considering circuit requirements, operating conditions, and quality level. For many applications, there is only one optimum capacitor and it is the repsonsibility of the customer's design team and the manufacturer to determine what that optimum device is.

Customer's check list

When specifying a capacitor—either commodity or custom—the following factors should be carefully determined to enable choosing the optimum part for the specific application:

Capacitor parameters

1. *Capacitance*—tolerance and drift with temperature, voltage, or frequency
2. *Voltage*—nominal, peak, superimposed, reverse, derating
3. *Insulation resistance*—variation with temperature
4. *Power factor (dissipation factor, quality factor)*—variation with temperature and frequency
5. *Leakage current*
6. *Dielectric absorption*—variance with temperature
7. *Equivalent series resistance (ESR) and inductance (ESL)*
8. *Effect of frequency, resonant frequency, and reactance*
9. *Impedance*
10. *Current rating, ripple current rating, pulse rise time limits.*

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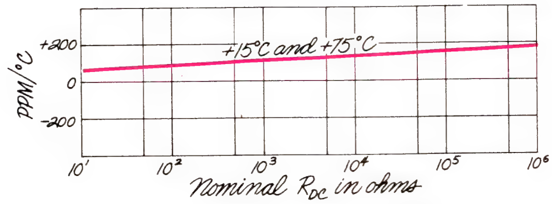

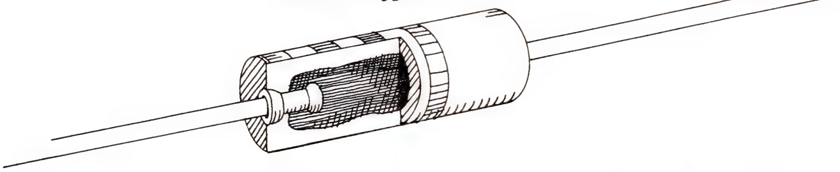

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Circle 57 on reader service card

Physical paramaters

1. *Shape of case*
2. *Material of case*—cleaning, circuitry of case if metal-cased
3. *Terminal positions*
4. *Type of terminal*—solderability
5. *Method of mounting*
6. *Suitability of use with automatic assembly equipment*—supplied on reel, tapes, etc.
7. *Potting or secondary encapsulation limits*

Environmental limits

1. *Temperature*
2. *Humidity*
3. *Vibration*
4. *Acceleration*
5. *Shock*
6. *Air density*
7. *Nuclear radiation*

Reliability

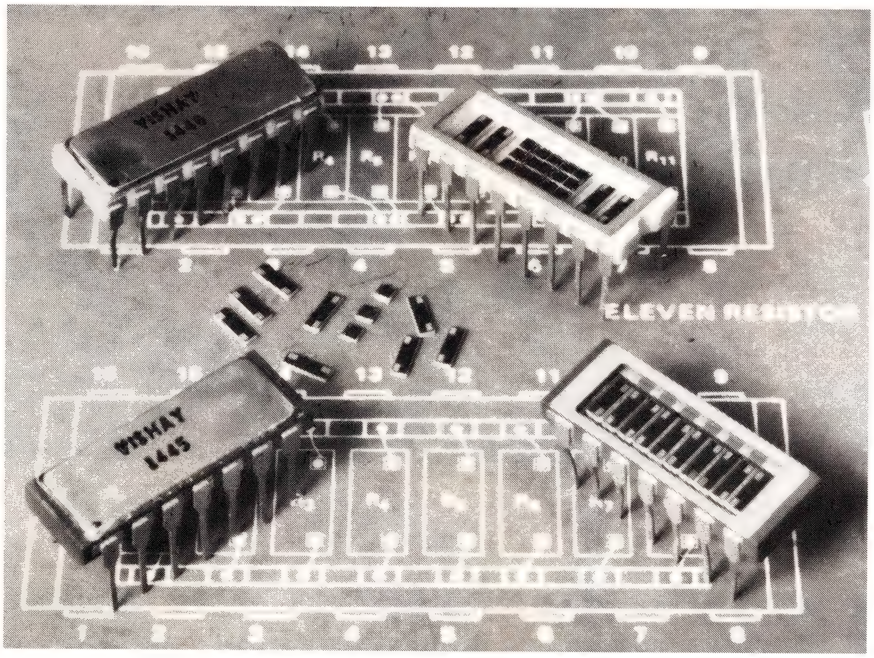
1. *Specification*
2. *Maximum failure rate*
3. *Calculated failure rate at current/ equipment parameters*
4. *Mode of failure*
5. *Capacitor limiting factors for reliability*—temperature, voltage, circuit impedance, etc.

Much of what has been said about the capacitor market—its certain evolution to newer technologies, the impact of surface mounting, the changes expected in marketing—is as true for the other major passive component sector, if not more so.

Strong resistor market

The resistor market will continue a slow, but steady, change from old to new technologies, assuring the designer, manufacturer, and OEM customer a stable source of established products, while offering an expanding catalog of new entries.

Last year total consumption of resistors was $887.8 million. The dominating technologies continue to be metal film, wirewound, and thick and thin-film networks. Of the total $310.3 million sales of fixed resistors, 34% was for metal film, 28% for wirewound, 12% for chip, 15% for carbon composition, and 8% for carbon film. Other technologies were insignificant. These percentages are expected to remain essentially the same throughout the decade, although chip resistor sales are expected to cut some percentage points out of the pie chart at the expense of carbon film and carbon composition types.



Tight. Vishay has received characteristic C MIL spec approval of these 14- and 16-pin hermetic and non-hermetic DIPs. Tolerance is to ±0.1% and TCR is ±50 ppm/°C. [Circle 403]

Sales of film and resistor-capacitor (RC) networks for 1984 was $176.9—73.3% for thick film networks, 15.2% for thin-film, and 11.6% for RC networks. These percentages are expected to hold for the remainder of the decade, says Gnostic Concepts.

Most industry analysts see only a modest increase in resistor sales this year as inventories are liquidated after 1984's excessive buying. According to John Younker, marketing manager of Capco Inc., some tapering off is inevitable. "A year ago we were at an all-time high. Users were building inventories because they were relating passive components, which were in reasonably good supply and available with no lead time in 1984, to some of the active components, for which there were long lead times and scarcities. They just overbought."

Surface mountable components will continue to make inroads, as will thin- and thick-film networks. The importance of networks can be seen in projected sales figures. By 1989, sales of fixed resistors are projected to be $397.5 million, compared with network sales of $248.4 million.

Manufacturers can expect selective areas of competition from overseas both from foreign manufacturers, and American firms buying abroad for resale in the U.S. Pressure will be felt where low price is a selling point—conformal coated networks, for example. Major Japanese investment in automatic placement machinery and their large lead in surface-mounting will spur movement in the U.S. to play catch-up if companies here are to stay in the manufacturing game.

"Domestic OEMs are now recognizing the miniaturization, reliability, and cost advantages of suface-mount technology that Japanese manufacturers of high-volume consumer electronics have known for years," says Brent M. Curtis, president of Mepco/Electra Inc. "As a result, the U.S. market for suface mountable components is just

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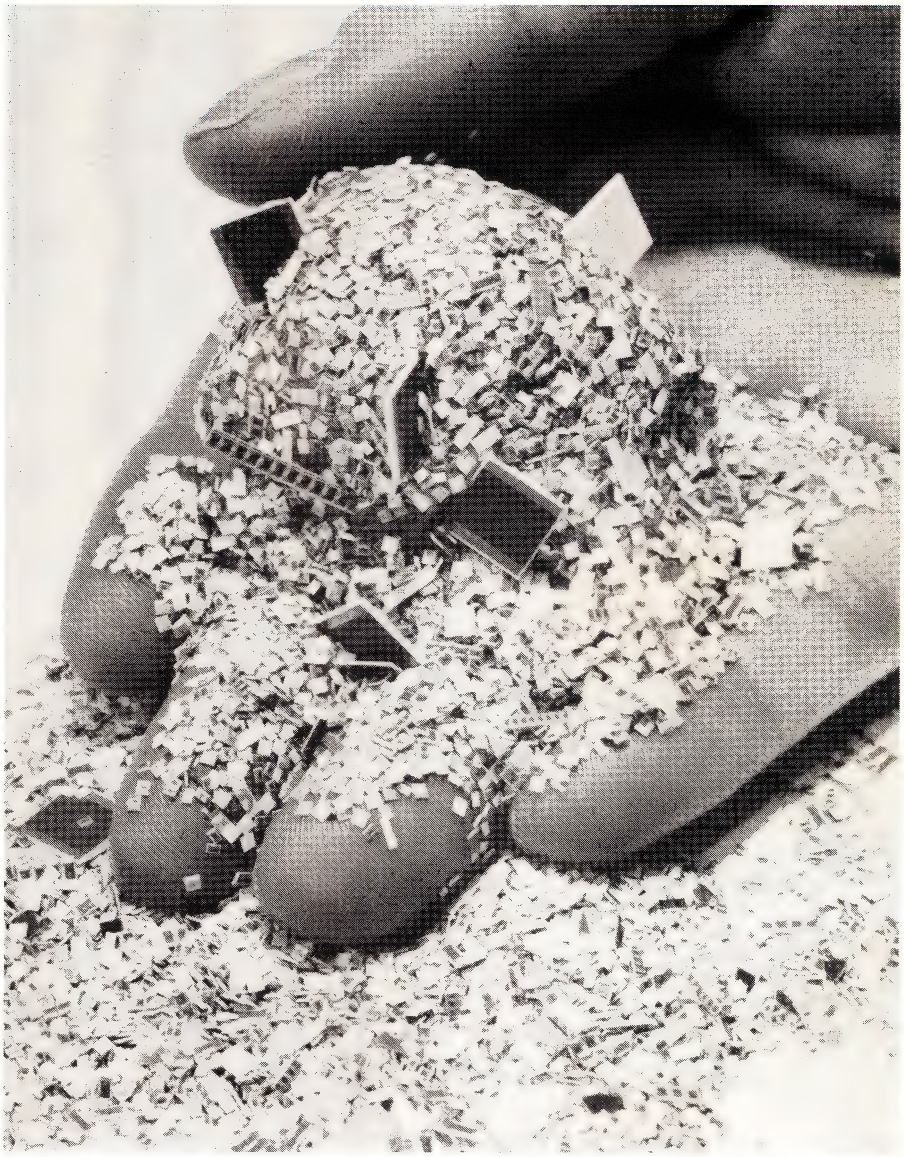
Circle 59 on reader service card



Choice. Chip resistors for surface mounting come in a wide variety, as evidenced by International Manufacturing Services' selection of values from 10 Ω to 24 MΩ. [Circle 404]

beginning to develop, but will grow dramatically over the next five years."

Of all the established resistor technologies, thick-film resistor networks will continue to enjoy the greatest growth rates (but a slightly declining rate vis-à-vis thin-film as the 1980's progress), benefiting from the technological innovation and changes mentioned above—leadless chip carrier packages and surface mounting, in addition to the reduced space requirements of computers and the use of automatic placement equipment.

The thick and the thin

In designing thick-film resistor networks, RC networks, and ladder networks, the designer should consider the following performance characteristics of needed components:

- Thermal shock resistance
- Power dissipation
- Resistance to solvents
- Overload damage
- Temperature coefficient of resistance and/or capacitance
- Humidity resistance
- Load life
- Temperature cycling
- Resistor and/or capacitor characteristics
- Capacitance and tolerance
- Capacitor dissipation
- Moisture resistance
- Resistance to mechanical shock
- Solderability
- Vibration resistance

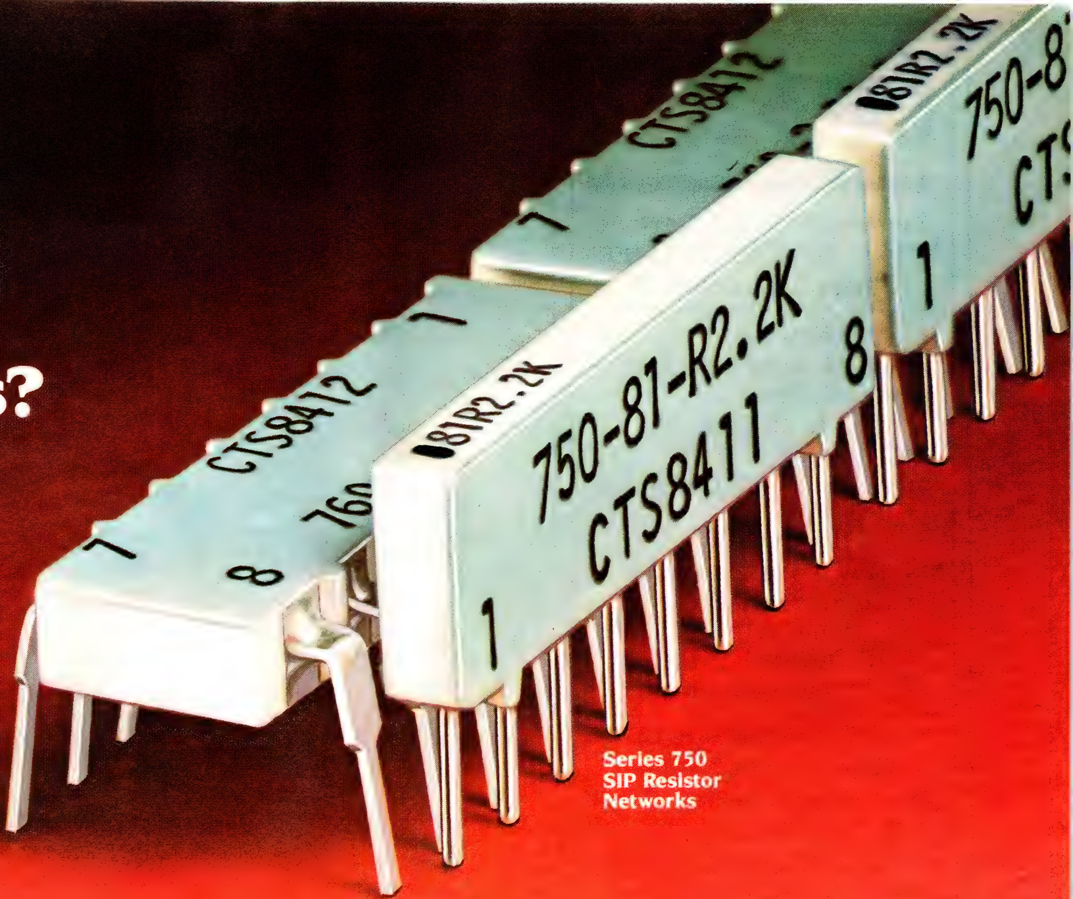
The thin-film resistor market moved quickly past the stage of infancy, and is establishing itself as a dependable, if small, market. "The advantage of improved coefficients and resistance tolerances give this product a competitive advantage over the other resistor technologies," says Margaret Nowicki, advertising coordinator for Dale Electronics Inc.

Although not a technology destined for dollar volumes of those of the thick-film resistor counterpart, significant growth will continue for years to come.

Thin-film manufacturer Hybrid Systems suggests that designers specifying a thin-film circuit consider several important design perameters, and work closely with their vendor during all stages preceding shipment:

- Size. Dimensions are generally determined by power density based on thermal dissipation, range of resistance values, pin-outs, internal probe pads, conductors' current capacity, sheet resistivity, bonding techniques used, and resistor trim range. There are other dimensional constraints such as board layout and internal package cavity size.
- Power dissipation. Thin-film elements do not carry the same power dissipation specifications as do discrete resistors, i.e., ⅛ W or ¼ W, etc. They do have similar ratings, but these must be considered as total average power density. Layout must provide for a uniform distribution of substrate operating temperature. This requires that the resistors be positioned so that each resistive element's contribution to the total dissipation does not unbalance the network's thermal profile. The layout must also consider the applied voltage range or actual range of dissipation for each element—both transient and steady state.
- Tolerance—absolute vs. ratio. Absolute tolerance is associated with a specific or individual resistor. Ratio is the relationship of two resistors to

Why inspect incoming resistor networks?



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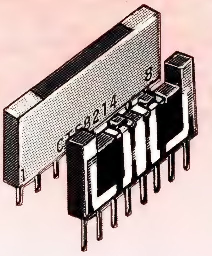

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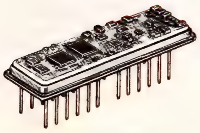

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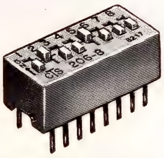

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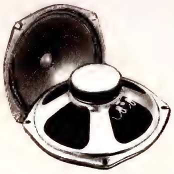

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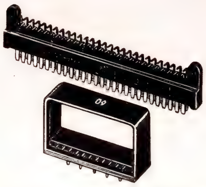

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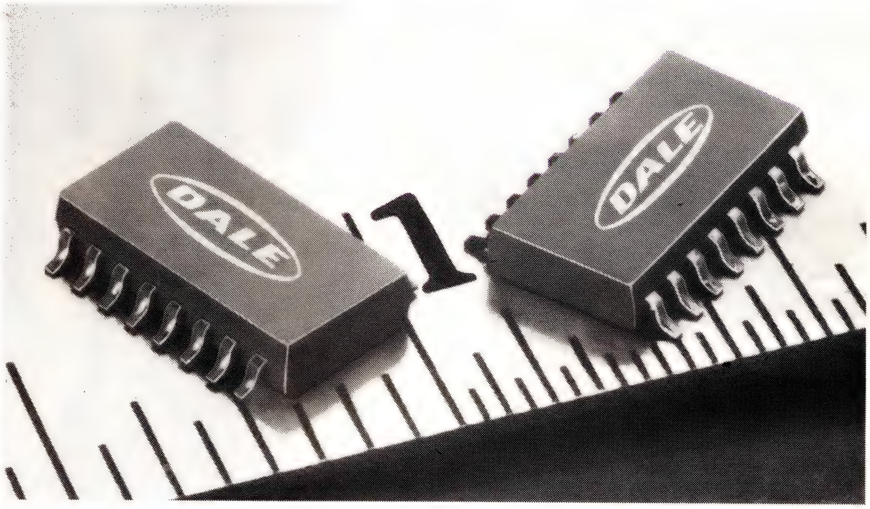

Small but standard. The industry standard "small outline" configuration is now being used by Dale Electronics to provide thick film resistor networks for surface mounting. [Circle 405]

each other given as a proportion. The designer must consider the cost savings that can be realized by specifying ratio tolerances rather than tight absolute accuracies. For example, Hybrid Systems' thin-film materials offer temperature coefficient of resistance tracking—the change in resistance with temperature specified in ppm for a defined temperature range—to ±2.5 ppm/°C, with initial resistance ratios to ± 0.02%.

■ Tracking requirements. The layout must take into consideration which elements must have ratio accuracy over various environmental ranges. Those resistors that must ratio track need to be located in close proximity to insure optimum tracking.

■ Trim constraints. It must be determined whether the vendor will trim the resistors or if the circuit will be shipped untrimmed and be completed by the designer. There are a number of considerations that must be addressed. These include resistor element power density, trim range and substrate size and, of course, cost.

Getting military precision

Engineers at Vishay Resistive Systems Group have discoverd a loophole in the stability requirements for RNC90Y precision resistors which might allow for a degradation of stability of an order of magnitude.

To gain approval under MIL-R-55182/9 (RNC90Y) for Established Reliability resistors, the manufacturer must undergo a qualification test. Once this qualification test is successfully passed, a maintenance testing program has to be followed to continually demonstrate conformance with the requirements of the military specification.

But did you know that the specification limit for initial qualification is different than the limit for maintenance testing? For example, during qualification testing (to MIL-R-55182/9) for load life, resistors are exposed to 0.3 W at +125°C. The permissible $\Delta R/R$ shift is ±500 ppm (0.05%) during the first 2,000 hours of load life and ±5,000 ppm (0.5%) during the next 8,000 hours.

During maintenance testing, after the manufacturer has been qualified to the RNC90Y specification, the permissible $\Delta R/R$ shift is ±5,000 ppm at any time during load life testing. Hence, even a resistor showing a ±5000 ppm shift after 100 hours is not out of specification provided it does not exceed ±5,000 ppm during the next 9,900 hours. The customer is therefore buying, under RNC90Y, a 0.5% stability resistor, not a 0.05% stability resistor. □

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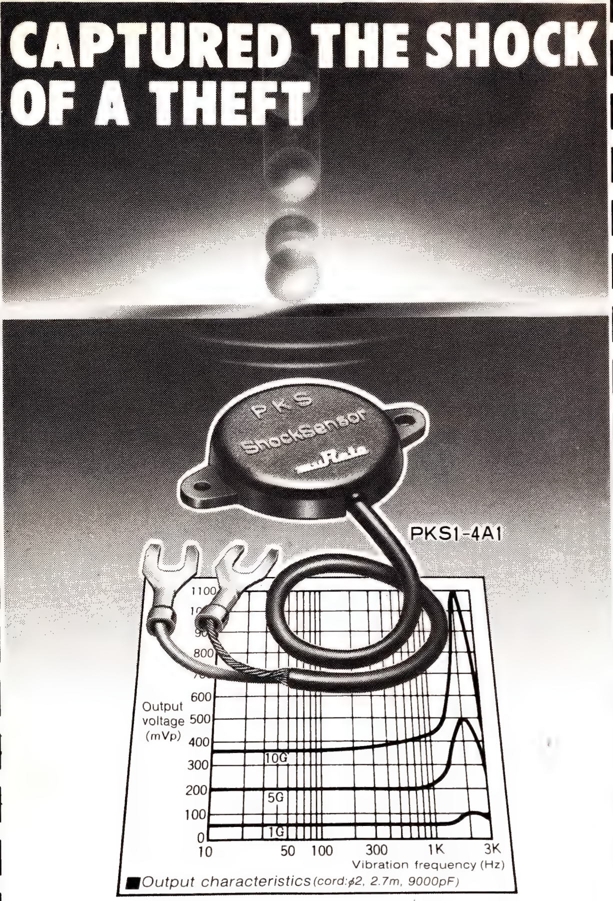

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■Specifications

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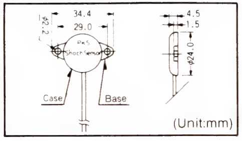
Insulation Resistance	30MΩmin or more (100VDC)
Operating Temp. Range	−20～+60℃
Storage Temp. Range	−20～+70℃
Strength of Lead Wire.	250g for 1min along axis.

■Dimensions(PKS1-4A1)



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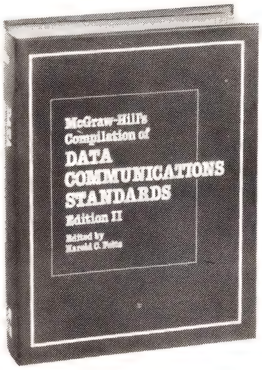
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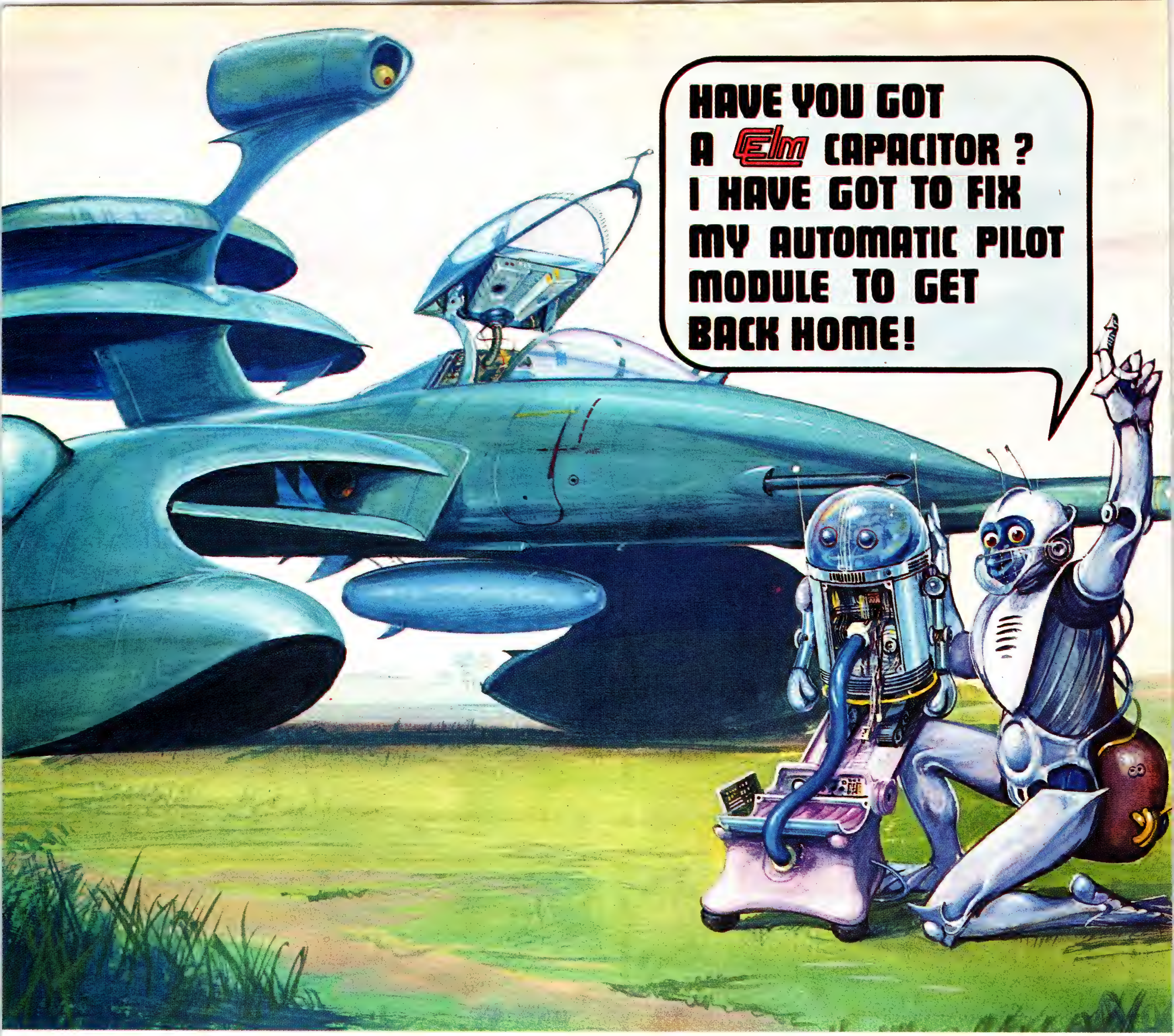
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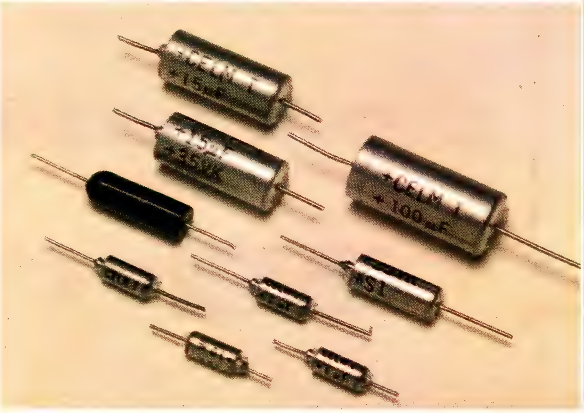

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NEW PRODUCTS

A GATEWAY TO SUPERNETS

Node controller transcends processor types and operating systems to build networks, transmitting data at 2 Mb/s over video-grade cable

☐ *by Ann Jacobs*

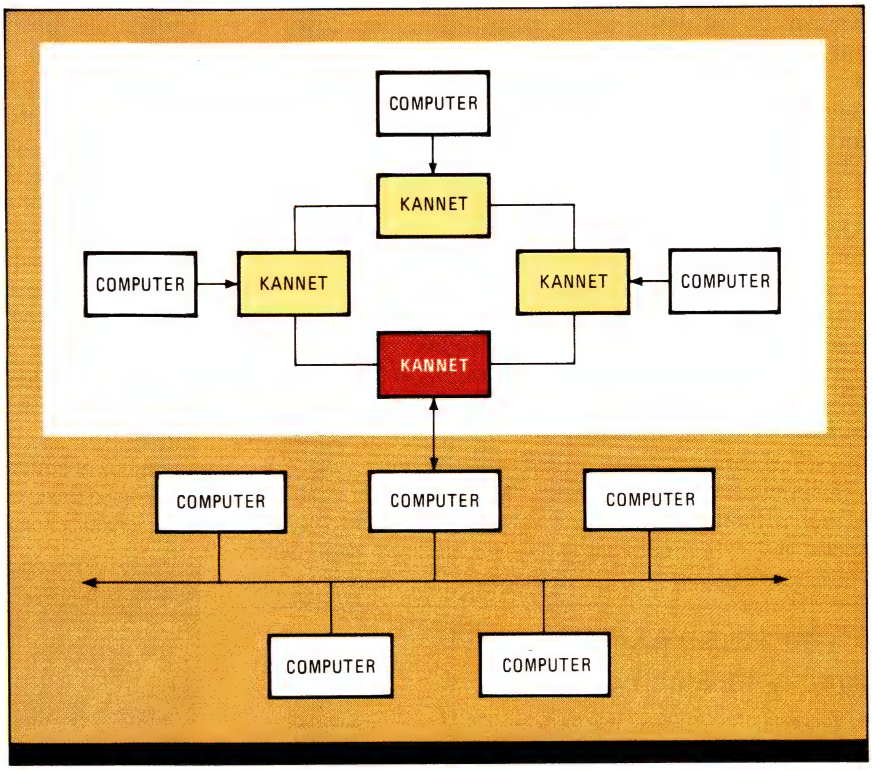
Supernets—two or more linked networks, often of different types—are the future of computer networks and the target that systems designers will be challenged to hit. The key to the supernet is the internet gateway. Gateways must handle the protocols used by both networks; they must also be able to convert data packets, enforce access controls, and perform other tasks.

Now Kannet, a multiple-token-ring-topology network, simply creates gateway computers to manage supernets from ordinary microcomputers, tapping into networks that can be composed of a variety of computers and peripherals running under different operating systems. The only requirement is that at least one computer in every network to be linked must have a Kannet unit attached to it. It is preferable that this machine be some central computer or file server that has access to all the available resources that the network allows.

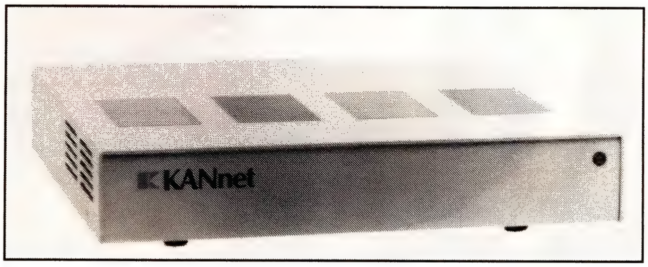
Supernets are an easy extension of the versatile Kannet system, whose basic job is to build a network that contains a mixture of machines, operating systems, and peripherals. With a Kannet, every computer in the network can allow its own resources to be used by other computers and can use resources on every other computer. Every computer can share its files and peripherals with any or all of the other computers in the net, and every computer can directly use any resource that another computer allows it to.

Kannet consists of a 2-by-12-by-12-in. box containing its own power supply; a machine-specific personality module that mounts in an I/O expansion slot in the host computer; two connectors that link to the previous and to the next Kannet in the ring; and a floppy disk. Each Kannet is connected by means of RG58 or similar video-quality coaxial cable, and active nodes can be located up to 2 km apart. If a host computer is replaced, all that is necessary to integrate the new computer into the Kannet is a new personality module and program disk. With the required hardware and software, per-node costs are $1,395.

Intelligence is the key to Kannet's ability. The software includes four types of programs: the network driver (one per operating system, which can be MS-DOS, PC-DOS, CP/M-86, or CP/M-80) for bringing a computer into the network; utility commands—all Kannet utilities



Super duper. A Kannet network may tap into other networks, even those of a different type. Only one computer—the gateway—on the other net needs to be attached to the Kannet controller. All of the other net's resources are available to the computers on the Kannet.



are written in C language—for configuring and initiating tasks such as resource sharing and electronic mail; printing utilities; and utilities that serve as examples for those who want to write their own programs.

Resource sharing among the Kannet boxes is simple. Since each node has its own drivers, receivers, and message buffering, there are no collisions, as would be the case in a bus topology. Also, there is no bottleneck computer that has to receive and reroute all the messages, as in star topology.

Files can be shared selectively throughout the entire network and accessed simultaneously without data corruption; the user can lock his or her chosen files by means of priority levels and passwords. Disk sharing is done at the file level, not at the drive or partition level.

A hard disk on Kannet is used purely for storage, not as a file server, and therefore is not necessary for the network to function; nor is it necessary to partition it if one is used. Moreover, the net accommodates computers that allow hard-disk chaining.

Operation of the network is not affected by powering a Kannet up or down or by powering up or down any individual computer. Kannet also differs from systems with servers, wherein the server not only provides the shared resources but also functions as the message director for the network. In such a system, if the server unit fails, the network goes down.

Printers can be shared by computers regardless of where they are physically connected. Like printers, modems are accessible to every computer on the network.

Two kinds of communication are possible with Kannet: electronic mail and split screen. The electronic-mail feature stores the message in a mailbox, then alerts the the receiver. For split-screen communication, the operators of two computers each run a utility program called Netcom. With it, messages are typed on the top half of the screen and received on the bottom half.

Kannet sends variable-sized packets at a data rate of 2 Mb/s, without the need for data-collision control.

Kantek Inc., 13730 N.E. 20th St., Suite J, Bellevue, Wash. 98005.
Phone (206) 644-2970 [Circle reader service number 338]

Server links VAX/VMS directly to Ethernet

A hardware/software package multiplexes/demultiplexes up to 32 VAX/VMS terminal ports. The Integrated Network Terminal Server for VAX/VMS systems (INTS/VMS) functionally replaces four NTS10 units attached to 32 DMF32 or DZ11 ports, thus offering a direct Ethernet/IEEE 802.3 local-area-network link for VAX/VMS systems. The INTS/VMS board occupies only one Unibus slot.

The network processor board features a dedicated 80186 16-bit microprocessor, an intelligent direct-memory-access interface to the host system, 256-K bytes of memory and an 82586 Ethernet controller. It is fully compatible with the company's NTS10 Terminal Server and other network products.

The software is installed without change to the VMS operating system and includes the protocol module, terminal-port driver, automatic program boot loader, local-console access program, and network down-line boot-server program.

The product is available in 30 days after receipt of order at a cost of $6,190.

Interlan Inc., 155 Swanson Rd., Boxborough, Mass. 01719.
Phone (617) 263-9929 [Circle 341]

Network interfaces allow PC-Opennet communication

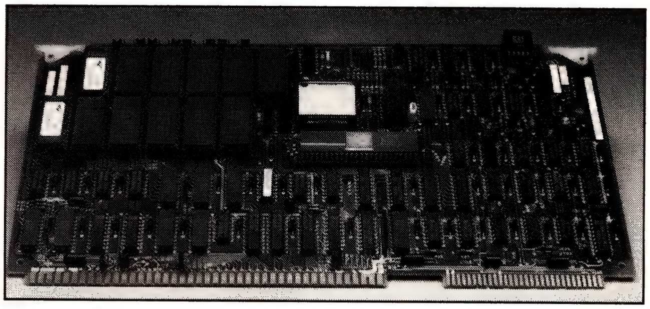
A pair of what the manufacturer calls personal connections allows IBM Corp. Personal Computers to communicate with Intel's Opennet local-area network. The connections are based on the company's existing board-level network controllers and software developed jointly with Intel Corp.

The two products—the Personal Network Interface Controller and the Personal Network Interface Unit—are designed to allow IBM PCs, PC/XTs, and selected PC-compatible microcomputers to communicate with the Opennet LAN.

Because Opennet is based on industry-standard protocols and supports dissimilar operating systems, the company believes original-equipment manufacturers will use it as a building block for their own network systems.

The two connections plug into an expansion slot on the PC, providing the necessary link between the personal computer and Ethernet LAN. The interface unit executes all network communications protocols in its Intel 80186 microprocessor, while the interface controller, designed for use in IBM PC work stations, executes its protocols in the personal computer. Using the customized software, which includes a copy of Microsoft Networks, the personal computer can communicate with Opennet products.

Ungermann-Bass Inc., 2560 Mission College Blvd., Santa Clara, Calif. 95050. Phone (408) 496-0111 [Circle 340]



Package links Unix, RSX-11M, and VMS systems

Any combination of microcomputers and peripherals based on the AT&T Bell Laoratories Unix, VMS, or RSX-11M operating systems can be interlinked with the EXOS 200 Series of front-end processors and companion EXOS 8000 Series protocol software.

The company already offers front-end processors designed for each operating system; now it adds to the series a core module that can support any of the three operating systems. By making interface modifications, original-equipment manufacturers can integrate the front-end processors into the host computer or incorporate them in their proprietary bus. The EXOS 200 is compatible with Ethernet V1.0, V2.0, and IEEE 802.3 networking standards.

The protocol software packages are based on standard Arpanet protocols including Transport Control Protocol/Internet protocol and application utilities. The EXOS 8030 package supports Digital Equipment Corp.'s PDP-11 and LSI-11 machines, which use the RSX-11M operating system; the 8040 supports DEC's VAX-11/730, 11/750, and 11/780, which use the VMS operating system. An earlier model, the 8010 package, supports all the popular versions of Unix.

The hardware and software are offered on a licensing fee and royalty basis, with volume discounts. The EXOS 200 module's fee is $45,000; for 1,000-plus-copy quantities, royalties will be $50. The combined licensing and development fees for the 8030 and 8040 are $12,000 and $24,000, respectively, with royalties of $100 and $150 for 1,000-plus copies.

Excelan Inc., 2180 Fortune Dr., San Jose, Calif. 95131.
Phone (408) 945-9526 [Circle 342]

IC combines transceiver with encoding/decoding functions

Addressing the networking and data-communications marketplace, the Am7960 coded-data transceiver is a combined Manchester encoder/decoder and transceiver. It is designed for use in synchronous communications systems that require common-mode isolation in point-to-point or common-bus architecture.

It is suitable for operation at data rates from 500 kb/s to 3 Mb/s. Operating from 5 V, it provides 32 dB of dynamic range and guarantees 2-V output into 37.5 Ω.

The Am7960 can be used by interfacing the component through transformer coupling to inexpensive twisted-pair or coaxial cabling. Together with a crystal and a serial communications controller, the Am7960 is ready for applications such as modem-less communications (since the chip is a transceiver), party-line configurations, and various Higher Data Link Control or Synchronous Data Link Control protocol networking schemes.

The chip replaces small-scale- and medium-scale-integration implementations that consist of 25 or more conventional logic ICs. Priced at $15 each in lots of 100, the Am7960 is available from stock.

Advanced Micro Devices Inc., 901 Thompson Place, P.O. Box 3453, Sunnyvale, Calif. 94088.
Phone (408) 732-2400 [Circle 378]

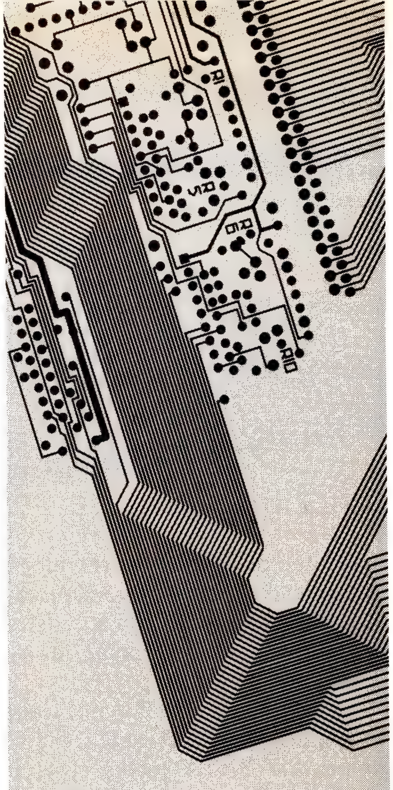
Voice/data office system requires no rewiring

An integrated office system converts an existing private branch exchange system to a voice/data system without extensive rewiring.

The DATX integrated office system, consisting of a DATX 2000 remote station and a DATX switching system, dovetails data and voice signals so that both may be carried simultaneously over existing telephone wiring. The system can be integrated into a fully controlled remote office network with either Megamux or Netcom.

The DATX 2000, which provides transmission access between remote terminals and the CPU, transmits both synchronous and asynchronous data at speeds up to 19.2 Kb/s with complete transparency and integrity of voice/data communication.

The switching system provides communication links for 360 lines,



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Circle 67 on reader service card

expandable in 24-channel increments to up to 1,320 terminations. As currently configured, the switching system is capable of transmission speeds of 9.6 Kb/s, but future upgrades will accommodate transmission equal to the DATX 2000.

Pricing for a typical point-to-point system, sufficient for 24 lines, begins at about $11,000; for more complex systems, the DATX switch costs about $17,000, depending on the required configuration. Delivery can be expected within 30 days from receipt of order.

General Datacomm Industries Inc., Middlebury, Conn. 06762.
Phone (203) 574-1118 [Circle 350]

Traveling-wave tube features high gain, low phase noise

A medium-power traveling-wave tube, operating in the 14- to 14.5-GHz band, is an efficient unit designed for Ku-band communications uplinks.

The TH 3639A features high signal gain (56 dB) and low phase noise. Incorporating a tapered helix for improved linearity, it has an external anode-voltage feedback loop that helps to prolong tube life by cathode-current adjustments as the tube ages.

Installation and operation are simplified, the manufacturer says, by permanent-magnet-beam confinement (which results in a smaller unit) and simple conduction cooling, eliminating the need for liquid or forced-air cooling.

In quantities of less than 10, the TH 3639A costs about $13,000. It requires 90 days for delivery.

Thomson-CSF Components Corp., Electron Tube Division, 301 Route 17 N., Rutherford, N.J. 07070.
Phone (201) 438-2300 [Circle 349]

Power supply gets go-ahead for hazardous environments

A nominal 24-V (dc) power supply can control a Texas Instruments Inc. PM550-based industrial hybrid controller in a rugged environment.

The PM550-224 switching-regulator power supply is approved for Factory Mutual Division 2, so it can be used in plants with a combustible atmosphere. The unit eliminates the need for 110-V (dc) inverters, resulting in increased reliability and reduced costs, the company says.

The supply can provide power to two loop-access modules or timer/control access modules, as well as the PM550 side of two of the company's analog auxiliary I/O bases and three discrete I/O bases. It includes built-in protection against internal overvoltage, overcurrent, and undervoltage conditions.

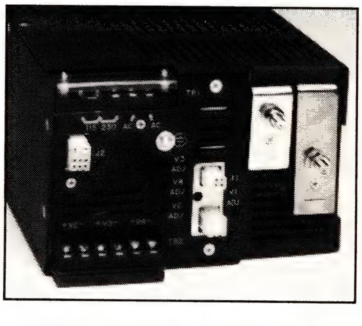
In the event of a power failure, it will maintain outputs to the central control unit for at least 38 ms to complete the program scan in progress. The PM550-224 operates in an ambient temperature range of 0°C to 60°C, and can withstand noncondensing relative humidities of 5% to 95%.

The supply also comes with two other features—an LED that indicates the status of the outputs and an alarm relay that can be used to control I/O power or to signal the occurrence of a fault. Available now, the PM550-224 sells for $2,555.

Texas Instruments Inc., P.O. Drawer 1255, Johnson City, Tenn. 37605. Phone (615) 461-2000 [Circle 356]

Power supply works in CAD/CAM applications

Designed for the computer-aided-design and -manufacturing markets, a five-output, 1,200-W (dc) switching power supply operates from a dual-range, user-selectable ac input.



Users can choose between single-phase ac inputs of 90 to 132 V and of 180 to 264 V. The system's main output delivers 5 V at 175 A; the four remaining outputs, all auxiliary, have selectable voltages. Auxiliaries 1, 2, and 3 can be specified for dc outputs of 2, 5, 12, 15, and 24 V. Output currents are different for each auxiliary: output 1 specifies a range of 10 to 20 A and output 2 a range of 6 to 10 A; output 3 supplies 6 A. Output 4 supplies dc voltages of 5, 12, and 15 V at 3 A.

Fewer power components are needed, thanks to the use of power MOS FETs. This, coupled with a unique hybrid thermal design, increases the product's reliability, the company claims.

The 21-lb unit, which includes a variety of standard interface signals, sells for $1,204 in orders of 100. Evaluation quantities are available on request; larger quantities take 6 to 12 weeks for delivery.

ETA Power Systems Inc., 2675 Junipero Ave., Signal Hill, Calif. 90806.
Phone (213) 427-0095 [Circle 357]

Two static RAMs need only 0.05 mA for standby

A pair of low-current CMOS static RAMs are designed for applications where batteries are required for data retention during power failures. The S6514 and S6516 use p-channel transistor loads to maintain low leakage currents even at high temperatures.

Standby current of 0.05 mA is standard on the S6514, which operates at 7 mA maximum on a 5-V power supply. The S6516 can stand by on the same 0.05 mA, but uses up to 10 mA while operational. Data stored in each chip can be maintained even when the power supply is reduced to 2 V.

The S6514, organized as 1-K by 4 bits, and the S6516, organized as 2-K by 8 bits, operate synchronously with on-chip address registers. Common data I/O pins allow direct interface to microprocessors that use a multiplexed address/data bus, such as Intel Corp.'s 8086. All of the part's inputs and three-state outputs are TTL-compatible.

The S6514 features access times of 150 ns (in the commercial temperature range), 200 ns (industrial), and 300 ns (military). The two versions of the S6516 have worst-case times of 120 and 200 ns.

Production quantities of the S6514 are now available in 18-pin plastic DIPs for $3.30 each, in lots of 1,000 pieces. The S6516 is available now in small quantities for evaluation in a 24-pin plastic DIP for $20.15 each, in 1,000-piece units.

Gould AMI Semiconductors, 3800 Homestead Rd., Santa Clara, Calif. 95051.
Phone (408) 246-0330 [Circle 353]

ROM accesses in 150 ns, has automatic power-down

A 1-Mb static ROM chip uses the company's high-performance MOS process to achieve access times as fast as 150 ns. The company claims it is compatible with any microprocessor on the market.

Organized in a 131,072-word-by-8-bit configuration, the SM231024 uses 70 mA of current while active, 20 mA on standby. The ROM chip features automatic power-down, providing system-level power savings of up to 80%. When automatic power-down is selected, the chip remains in a low-power standby mode for as long as necessary.

Packed in 28-pin ceramic or plastic DIPs (Joint Electron Device Engineering Council approved pinout), the SM231024 is available now for $35 each, in quantities of 5,000.

Silicon Macrosystems Inc., 3208 Scott Blvd., Santa Clara, Calif. 95054.
[Circle 354]

256-K bit EEPROM needs just 100 ns for access or erasure

What is said to be the world's first 256-K electrically erasable programmable ROM can store the equivalent of one page of text from a newspaper, according to Toshiba Corp., which developed the prototype flash EEPROM.

The as-yet-unnamed product, which the company expects to begin shipping before the end of the year, features a typical access time of under 100 ns. It requires less power than conventional chips of its kind, and it reduces the time and cost users need to rewrite information stored on the chip.

The memory chip is one third the size of most other EEPROMs (and about the same size as most

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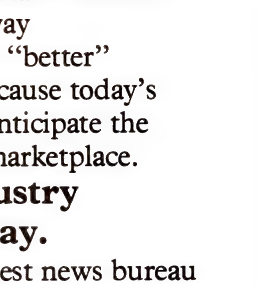

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EPROMS). It can be erased in less than 100 ns, compared to the nearly 15 min required by conventional EPROMs that use ultraviolet light rays to erase stored data. Pricing and exact availability have yet to be determined.

Toshiba America Inc., 2692 Dow Ave., Tustin, Calif. 92680. Phone (714) 832-6300 [Circle 355]

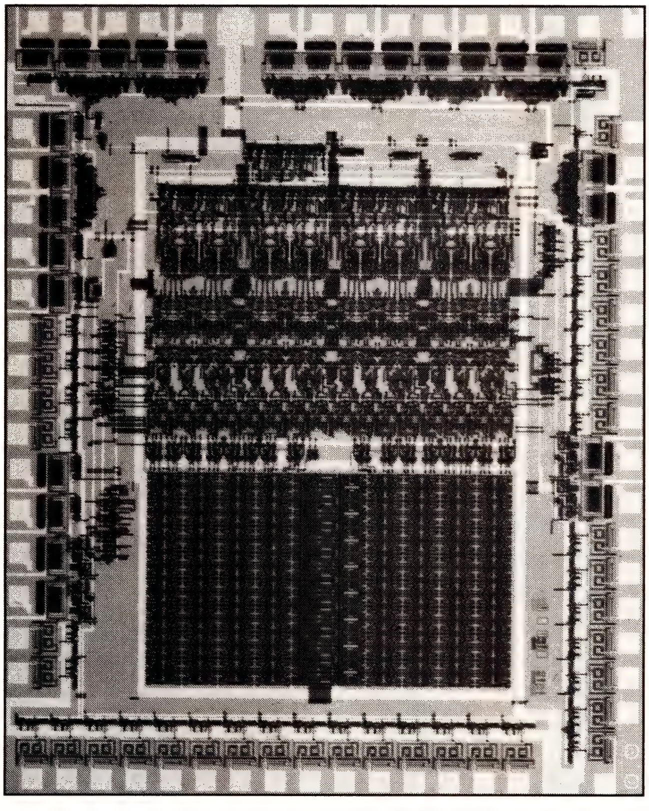
16-bit processor combines CMOS and bit-slice design

Fast, versatile, and cost efficient, the WS59016-C 16-bit processor combines the low power advantages of CMOS design with the speed of bit-slice architecture.

The chip—the first CMOS part to achieve full bipolar speeds, according to the manufacturer—contains four processing elements that are functionally identical to bipolar 4-bit 2901C bit slices and a 2902-equivalent carry look-ahead unit. Together, these elements allow the IC to act as the heart of a bit-slice system, replacing five discrete integrated circuits.

Designers needing 32 or more bits can cascade as many WS59016-Cs as necessary to meet the demands of the particular application. The circuit consumes about 27 times less power than standard bit-slice parts, or about 150 mW at 25°C and 10 MHz, compared with about 4 W for a bipolar product.

When supported by a system of components with comparable speed, the WS59016-C operates at a 15-MHz clock rate over the commercial temperature range (or 12 MHz, military). The commercial version's maximum I/O propagation delay is about 70 ns.



Two package options are available from stock: a 64-pin side-brazed ceramic DIP and a 68-pin plastic leadless chip carrier. The commercial-grade DIP costs $62 in quantities greater than 100; the commercial-grade chip carrier costs $50 each in like quantities.

Waferscale Integration Inc., 47280 Kato Rd., Fremont, Calif. 94538. Phone (415) 656-5400 [Circle 343]

8086 and 8088 bow in CHMOS for improved speed

Fully compatible with their 8086/8088 counterparts, Intel Corp.'s 80C86 and 80C88 microprocessors are designed in CHMOS, the company's proprietary high-performance CMOS process, for improved speed and efficiency.

Low power consumption, less heat dissipation, and lower susceptibility to noise are the primary advantages of the process, the company says. Power consumption is rated at just 10 mA per megahertz of clock frequency; standby consumption is only 0.5 mA. Clock frequencies up to 8 MHz will be available.

The CHMOS process uses epitaxial wafers featuring reduced resistance at the substrate level. This helps to eliminate parasitic voltage drops that can cause latchup.

A complete CHMOS kit of components is also being offered to support the microprocessors. A clock, bus controller, interrupt controller, timer/counter, peripheral interface, dynamic RAM controller, as well as EPROMs and RAMs are all available in the CHMOS system.

Samples of the microprocessors and support kits are available now, but production quantities will not be available until the fourth quarter. The 80C88 is priced at $20 each, in quantities of 500 or more; pricing for the 80C86 is about $25 in 500-piece quantities.

Intel Corp., Literature Dept. W-211, 3065 Bowers Ave., Santa Clara, Calif. 95051 [Circle 344]

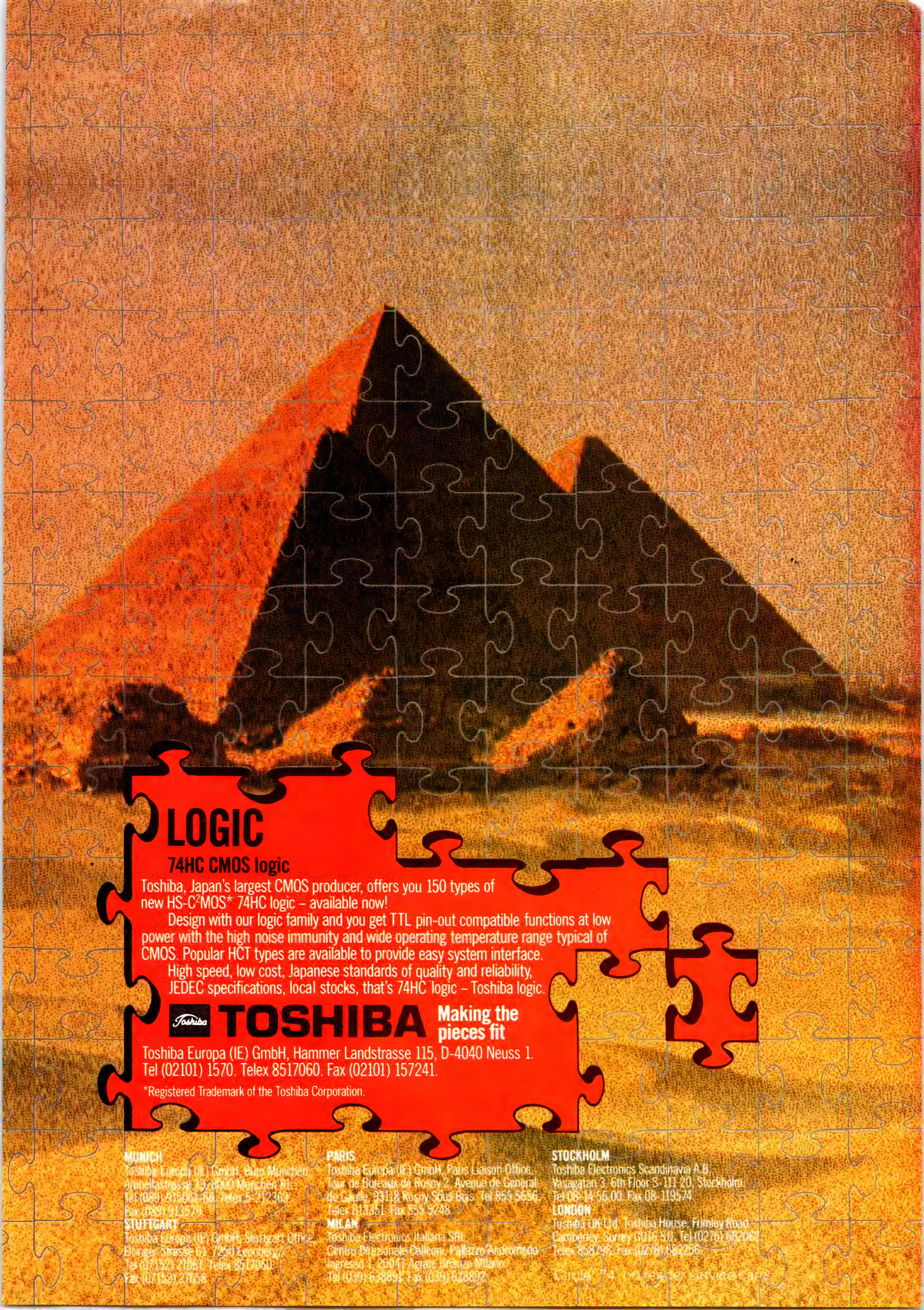
Design software carries schematics to source file

A link between the Dash-1 or Dash-2 schematic-capture software and the Abel programmable-logic design language is forged by Dash-Abel, a package that enables designers to automatically extract selected portions of a schematic and translate the schematic symbols into an Abel source file.

The designer first uses Dash to describe a circuit; then Dash-Abel assigns portions of the schematic to programmable logic devices; finally, Dash-Abel generates an Abel source file that describes the selected portions of the circuit. This file may also contain test vectors for use in circuit simulation.

Dash-Abel's function library contains a wide variety of TTL parts, and more can be added as wanted. To convert an existing TTL design, the designer defines those portions of the schematic that are assigned to programmable logic devices and then uses Dash-Abel to generate an Abel source file.

Dash-Abel is available for use on IBM Corp. Personal



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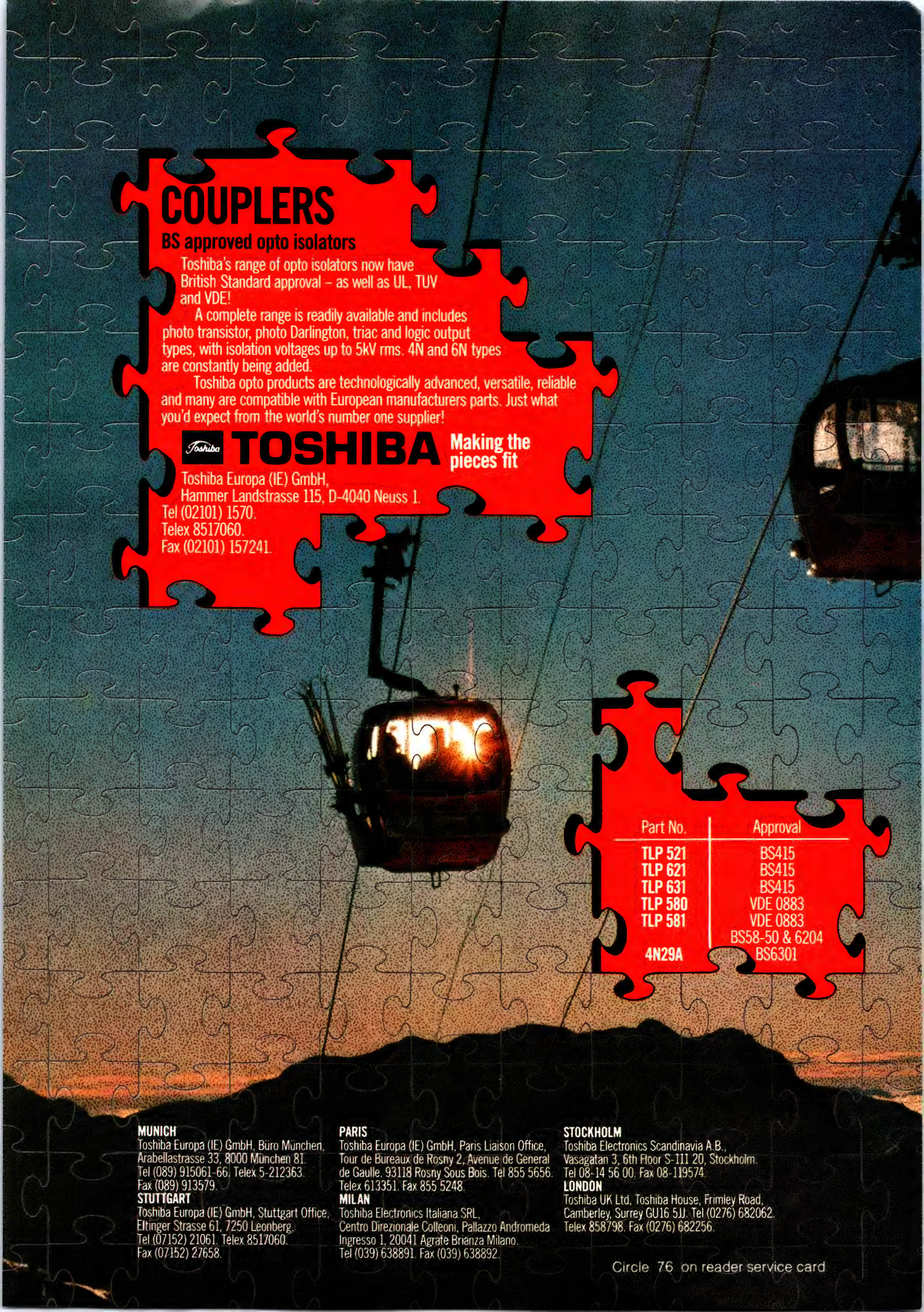

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Toshiba's range of opto isolators now have British Standard approval – as well as UL, TUV and VDE!

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TLP 631	BS415
TLP 580	VDE 0883
TLP 581	VDE 0883
4N29A	BS58-50 & 6204 BS6301

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Computers or compatible models. It is priced at $800, and shipments are made in three weeks.

Data I/O Corp., Customer Service, 10525 Willows Rd. N.E., P.O. Box 97046, Redmond, Wash. 98073.
Phone (800) 426-1045 [Circle 345]

Enhanced 8086 C compiler adds more functions

Version 3.0 of the company's C compiler has been enhanced to support all 8086 memory models, as well as hybrid memory models that previously were available only to assembler programmers.

Other enhancements include compiler and assembler source listings, source-level interactive debugging, closer adherence to the ANSI C standard, and full International Organization for Standardization level 1 implementation of Pascal. Pascal extensions are also offered, including a string data type, the ability to open files by name, and an "otherwise" clause in case statements.

By recompiling the source code, applications of Version 3.0 can be adapted from 8086-based computers to other CPUs, including the Digital Equipment Corp. PDP-11 and VAX, Intel Corp. 8080, Motorola Inc. MC68000, and IBM Corp. System/370. Object code can be produced for AT&T Bell Laboratories Unix, MS-DOS, CP/M, and other operating systems, including the manufacturer's own Idris.

C compiler Version 3.0 is priced at $1,000. With the optional Pascal extensions, the price is $1,300. Deliveries take four weeks.

Whitesmiths Ltd., 97 Lowell Rd., Concord, Mass. 01742.
Phone (617) 369-8499 [Circle 348]

Debugging software opens file-viewing windows

Debugging 8086 microprocessor applications is possible using an IBM Corp. Personal Computer and Genescope, a full-screen software-debugging tool. Genescope provides a file-viewing window so that source or listing files can be referenced during a debugging session, and lets the developer patch programs quickly with an on-line symbolic assembler.

Assembly-language mnemonics and program label names can be used instead of machine language, and source-level statement labels and procedure names can be used instead of absolute addresses. Genescope also lets the engineer see the code that is executing directly on screen.

Genescope runs under Access, the manufacturer's environment for running Intel's 8086 development software on the IBM PC and compatibles running under MS-DOS. (There is also an Access program that runs under CP/M-86.)

Retailing in single copies for $995 to $1,500 depending on the version, GeneScope is available with original-equipment-manufacturer licenses.

Genesis Microsystems Corp., 196 Castro St., Mountain View, Calif. 94041. Phone (415) 964-9001 [Circle 346]

Laser printer and network team to create Mac office

Up to 31 people using Appletalk, the firm's personal network, can also share Laserwriter as part of the system—which adds up to the Macintosh Office—to create near-print-quality documents at 300 dots/in. Users of IBM Corp. Personal Computers and compatibles can also make use of Laserwriter by means of a built-in program that emulates the Diablo 630 printer.

Laserwriter has been granted a license for Helvetica and Times Roman, two popular typefaces for newspapers and magazines that impart a professional look to office documents. More fonts will be added from the libraries of Mergenthaler, Linotype, International Typeface Corp., and others; the vehicle is Postscript—software that is being adopted as a page-description standard.

The printer incorporates a 12-MHz 68000 microprocessor plus 0.5 megabyte of ROM and 1.5 megabytes of RAM. Laserwriter's engine is a Canon LBP-CX10. Components that need regular replacement—toner and

imaging scroll—are contained in an easy-to-remove cartridge. Laserwriter sells for $6,995, including toner cartridge, and is now available.

Apple Computer Inc., 20525 Mariani Ave., Cupertino, Calif. 95014. Phone (408) 996-1010 [Circle 370]

Fast laser printer handles big sheets for CAD needs

Aimed at computer-aided design and in-house technical publishing operations, the 24/300 laser printer cranks out 24 pages/min and can handle 11-by-17-in. paper. Users can also print two 8½-by-11-in. pages on a single sheet.

The 24/300, built around the Xerox Corp. 2700 engine, is designed for heavy use of up to 60,000 pages a month. The printer's main input feeder has a 1,500-sheet capacity and an auxiliary feeder handles cover stock, letterhead, transparencies, labels, or just more paper. The output bin stacks jobs and multiple copies, allowing easy separation of different jobs. Letter- and legal-size paper can be intermixed in the output stacker with 11-by-17-in. paper.

The 24/300, which prints with a 300-by-300-dot resolution, emulates a variety of printers—daisy wheel, line printer, and Tektronix Inc.'s 4014 graphics device. Serial, parallel, and Ethernet interfaces are supported. Priced at $29,950, the 24/300 will be available in June.

Imagen Corp., 2650 San Tomas Expressway, Santa Clara, Calif. 95052. Phone (408) 986-9400 [Circle 371]

Tape system uses buffer, data compression for speed

Compatible with IBM Corp. and plug-compatible mainframe tape subsystems, the Intellistor 8520 Tape Optimizer and its associated controller, the 8500, provides three-channel data concurrency, buffered data transfers, and block multiplexer operation.

With an internal buffer memory of 0.5 megabyte (expandable to 1 megabyte), the I/O processor utilizes the host-processor channel only when transferring data, commands, or status information. Data is transferred between the unit's buffer and the channel at rates of up to 3 megabytes/s. The unit supports up to eight host-channel interfaces and up to four tape controllers.

Options include a hardware-based data-compression algorithm to increase tape reel capacity and performance. A second optimizer module can be packaged in the 8520 frame.

The company would not release prices for manufacturers, but estimated the end user's cost to be between $65,000 and $100,000. The product is currently available.

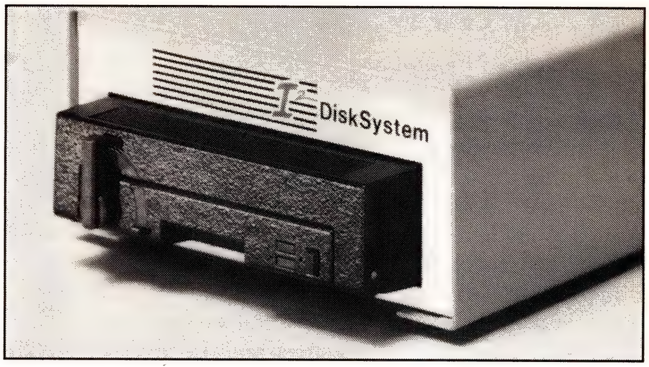
Intelligent Storage Inc., 2040 Miller Dr., Longmont, Colo. 80501. Phone (303) 678-0697 [Circle 373]

Disk drive gives IBM PC AT users personal Winchester

A removable cartridge Winchester-disk subsystem provides additional data storage, data security, and allows multiuse of a single IBM Corp. Personal Computer or PC AT. With a removable cartridge, each user can, in essence, have his or her own Winchester disk drive.

With 10.5 megabytes of formatted storage per cartridge, the Winchester drive fits into the B drive slot of the computer. The drive has a track-to-track access time of 22.5 ms. There is a 5 Mb/s data transfer rate and the system is totally plug-compatible with the PC or PC AT.

The cartridge for the PC costs $2,295 and the model for the PC AT costs $1,695. The prices include all of the necessary mounting hardware, software, and installation instructions.



Interface Inc., 21101 Osborne St., Canoga Park, Calif. 91304. Phone (818) 341-7914 [Circle 372]

Interface turns IBM PC into an instrument controller

Complete with support software and an applications program library, the GPIB Users Resource Utility, or Guru, is a toolkit designed to help integrate an IBM Corp. Personal Computer into a General Purpose Interface Bus (IEEE-488) instrument system.

Guru consists of a GPIB interface board with self-test/diagnostics, a shielded GPIB cable, a tutorial manual, and support software that includes a test-procedure generator and a subroutines library.

The test-procedure generator allows inexperienced users to create a program for a prescribed test sequence simply by entering the details of the task to be performed. The user follows instructions and answers ques-

tions to program the test, without ever needing any code. The subroutines library, consisting of 16 frequently used tests and functions, further speeds the test process by allowing the operator to focus on the problem at hand instead of on the computer.

Guru is priced at $600 and is available in two to four weeks.

Tektronix Inc., Marketing Communications Dept., P.O. Box 1700, Beaverton, Ore. 97077. Phone (800) 547-1512 [Circle 352]

Portable test system features 11 instruments in one

The functions of 11 separate instruments are combined in the model 2955 mobile radio communications test set, a 33-lb unit featuring a 5½-by-4½-in. CRT monitor for displaying test information.

Complete transceiver testing is possible with the 2955 because of its various functions. It operates as a signal generator; a modulation meter; a radio-frequency counter and an rf power meter; an audio-counter meter, audio-generator meter, audio voltmeter, and audio-distortion meter; a sinad meter; a codec; and an oscilloscope.

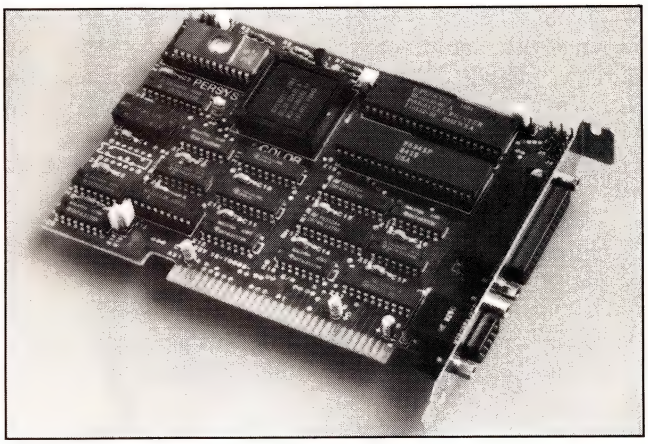
Control is maintained through color-coded keys for mode, function, numerical data, and units, as well as other selector keys and oscilloscope controls. The operator obtains results simply by invoking the name of the particular test to be performed and can read the results from the screen almost instantaneously. Nonvolatile storage of up to 38 front-panel settings further increases the test speed and the operator's productivity.

Rapid setup of simplex receivers is possible with an "Rx=Tx" key that sets the receiver test frequency to one measured or set during the transmitter test. Transmitter offsets and errors can thus be easily identified. Either single-port or two-port tests can be performed, and repeater systems may be tested—even when the transmitter and receiver are in different bands.

The test system costs $6,995, with delivery in 60 days.

Marconi Instruments, 3 Pearl Court, Allendale, N.J. 07401.
Phone (201) 934-9050 [Circle 351]

Graphics board has multiple resolution capabilities



A single-board graphics enhancement designed for use with IBM Corp. Personal Computers, the Persyst Short-port color card is completely compatible with IBM color-graphics software and monitors.

With graphics displays of 320 by 200 pixels at the four-color medium resolution and 640 by 200 pixels at the monochrome high resolution, the Short-port has, respectively, alphanumeric display modes of 40 characters by 25 rows and 80 characters by 25 rows.

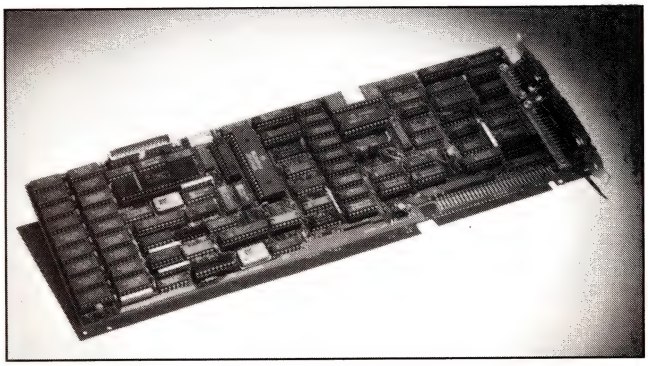
The 4-by-6-in. card, which features an optional parallel printer port and composite color output, offers direct-drive video output or an optional composite color output for access to low-cost composite monitors. An IBM-compatible light-pen interface is also included.

Using a standard IBM 256-character set, the board provides 16-K bytes of display memory. The card lists for $245 with the printer port, $220 without.

Emulex Corp., 3545 Harbor Blvd., P.O. Box 6725, Costa Mesa, Calif. 92626. Phone (714) 662-5600 [Circle 365]

Multifunction card adds graphics and memory

Not only does it provide high-resolution monochrome graphics to the IBM Corp. Personal Computer, but the Qc1029 multifunction board adds memory-expansion capability to 512-K bytes of parity-checked RAM, an asynchronous communications adapter that can be dedicated



to connecting an optional mouse, and a parallel-printer adapter.

The graphics mode provides up to two screen pages with a resolution of 720 by 348 pixels; the text mode provides the same resolution as the standard IBM monochrome adapter. The Qc1029's monochrome display adapter also features an on-board 64-K RAM screen buffer and it is compatible with Hercules software.

The board offers 256-K bytes of memory as standard, which can be doubled to an optional 512-K bytes. It provides monochrome graphics capability with higher resolution than Apple Computer Inc.'s Macintosh, the company says.

Designed for original-equipment manufacturers and personal computer owners wishing to upgrade their systems, the Qc1029 is available now for $699; dealer and distributor discounts are available.

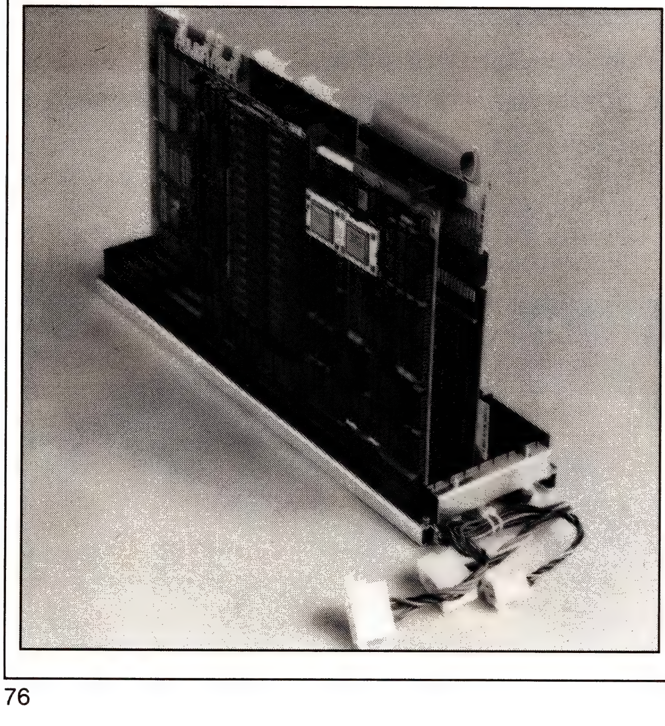
Quam Corp., 900 W. 128th St., Suite 208, Burnsville, Minn. 55337.
Phone (612) 894-2360 [Circle 366]

Upgrade changes PDP-11's processor to Q-bus

With more speed and memory—without the expense of trading up—the Microverter 73, a large-scale-integration 11/73 Unibus upgrade, converts Digital Equipment Corp.'s PDP-11 computers from a Unibus-based processor to Q-bus. The upgrade performs signal conversion from Q-bus to Unibus and 22-bit memory mapping for 18-bit Unibus models.

The Microverter 73 consists of a quad-width Microverter board, a dual-width power-regulator/console-interface board, a 1-megabyte memory board, an LSI-11/73 processor board, and a nine-slot backplane with four hex-width Q-bus slots and five Unibus slots.

The system replaces the old processor boards, memory, and backplane in the PDP-11 chassis. The system's memory can be expanded to 4 megabytes and it is compatible with RSTS/E and RSX-11M software.



Priced at $9,950, the upgrade is now available.

Able Computer, 3080 Airway Ave., Costa Mesa, Calif. 92626.
Phone (714) 979-7030 [Circle 364]

16-bit converter fits 12-bit pinout

Data-conversion applications using 12-bit parts can be ugraded to 16 bits without any hardware changes and only minor software modifications using the MP7636. The 16-bit converter is packaged in the same 20-pin format as the industry-standard 12-bit unit, the 1230.

The converter has an 8-bit port through which the 16-bit value is loaded 1 byte at a time. The converter has a fast settling time of 1 μs to within ½ least significant bit. The integral nonlinearity is 0.003% and is guaranteed over the entire operating temperature range.

In a plastic package, the converter is priced at $26 for 100 pieces. The ceramic package for the military temperature range is screened to MIL-STD-883 and sells for $38.50 for 100-piece quantities. The converter is also available in die form. Delivery takes four weeks after receipt of order.

Micro Power Systems Inc., 3100 Alfred St., Santa Clara, Calif. 95054. Phone (408) 727-5350 [Circle 369]

Interfaces integrate IBM PCs and mainframes

With the aid of two interfaces, an IBM Corp. Personal Computer can use and integrate information from IBM's VM/CMS mainframe computers.

The Multigate-PC permits the exchange of PC-DOS and VM/CMS files between a PC and the company's DCS 4500, which performs under-the-desk VM/CMS applications processing for up to eight PC users. The Multigate-PC relies on two components: the PC server for the IBM PC, and the Canaan server for the DCS 5400. The PC server places the PC into a Canaan TM5202 emulation mode, redefining the PC keyboard and function keys when connected to the DCS 5400. It also allows for toggling between a PC-DOS application and multiple VM/CMS sessions.

The Canaan server provides the PC-DOS file-transfer facilities to and from the PC; PC-DOS files stored on a DCS 5400 are treated as CMS files and protected under the CMS file-security system.

The Multigate-VM permits the further exchange of PC-DOS and VM/CMS files to another DCS 5400 or to a VM/CMS mainframe. Multigate-PC allows PC users to maintain complete application and file compatibility with the mainframe.

The Multigate-PC, which requires an RSCS networking license from IBM, is priced at $1,195 plus annual maintenance charges of $125. There is no charge for the Multigate-VM. The two facilities are available now.

Canaan Computer Corp., 39 Lindeman Dr., Trumbull, Conn. 06611.
Phone (203) 372-8100 [Circle 358]

New Literature

Sensitivity training. A 16-page catalog is available offering information on this company's full range of one- and two-dimensional position-sensitive detectors. These optoelectronic sensors provide continuous position data on a light spot traveling over their surfaces, and offer high position resolution, a wide range of spectral response, fast response, and simultaneous measurement of light intensity and position. Applications include laser-beam alignment, optical position and angle sensing, and optical rangefinders. For a free copy of this catalog, call Hamamatsu Corp. at (201) 469-6640, or write to 420 South Ave., Middlesex, N.J. 08846. [Circle reader service number 421]

Patently obvious. Designed as an easy-to-read source for technical professionals, the *1984 Annual Patent Directory* series from Communications Publishing Group Inc. includes directories for fiber optics, lasers and electro-optics, telecommunications, and semiconductors and ICs. Each directory contains information on specific U.S. patents and international patent applications issued from January to December 1984, with descriptions, drawings, and information on inventors, patent owners, and issue and filing dates. There is also a monthly update service. For more information, including how to order copies, write to the publisher at 1505 Commonwealth Ave., Suite 32, Boston, Mass. 02135; or call (617) 787-0138. [Circle 422]

Back to basics. An eight-page tutorial in the basic design elements of optical fiber, including construction and types, systems design, and cabling design, is offered at no charge. The brochure contains illustrations, graphs, and diagrams. Send requests for this free publication to Belden Electronic Wire & Cable, P.O. Box 1980, Richmond, Ind. 47375, or phone the company at (317) 983-5200. [Circle 423]

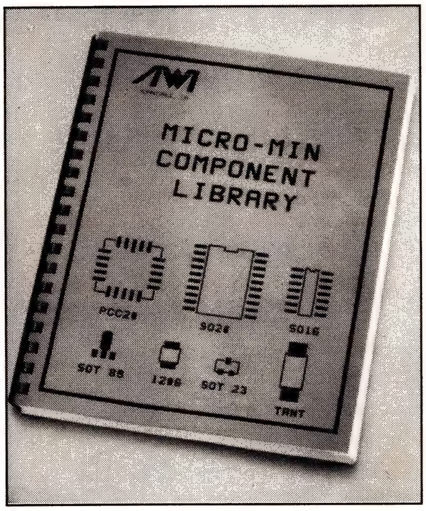
Top of the charts. Two selection charts for aluminum and tantalum electrolytics are featured in this full-line catalog of electrolytic capacitors. Complete descriptions and special features, applications, line drawings, and specifications are given for each type. Among aluminum types, offerings include miniature extended-temperature-range tubulars, high-frequency MIL styles, snap-in mounting, and a number of computer-grade components. The tantalum electrolytics include tantalum foil tubular, polar and nonpolar, etched and plain foil, wet anode, extended capacitance and temperature range, and more. The catalog is free from Cornell Dubilier, Wayne Interchange Plaza 1, Wayne, N.J. 07470, or call (201) 256-2000. [Circle 424]

Surface, but not superficial. The most commonly used commercial components in surface-mounting technology are described in the *SMT Standards Manual*, directed toward fulfilling the requirements of design engineers as well as purchasers. Each component is listed by manufacturer and includes the company's own mechanical outline drawing and the recommended footprint pattern for reflow process. Any deviations are noted. For ordering information, call the Nugrafix Group Inc. at (408) 395-5859, or write to them at 59 N. Santa Cruz St., Los Gatos, Calif. 95030. [Circle 426]

Chip shots. Surface-mounted chip capacitors, chip resistors, potentiometers, and trimmer capacitors are detailed in this eight-page technical brochure. The components are compatible with dual-wave, infrared, and vapor-phase soldering techniques. The brochure contains size information and packaging options, temperature coefficients, and voltage, capacitance, and resistance characteristics for each product. Free from Kyocera International Inc., the brochure can be ordered by phone from them at (619) 454-1800. Or write to 11425 Sorrento Valley Rd., San Diego, Calif. 92138. [Circle 427]

Small talk. Microminiature semiconductor packages—SOT 23 (TO-236), SOT 89, and SOT 143—star in this manufacturer's catalog. Device types listed are transistors (npn and pnp), single and dual diodes including Schottky, and a gallium arsenide Hall generator. Designed for thick- and thin-film hybrid circuits, the packages are compatible with automated assembly equipment. They are available in bulk or tape-and-reel pack. Request a free copy from Siemens Components Inc., Special Products Division, 186 Wood Ave. S., Iselin, N.J. 08830, or call them at (201) 321-3400. [Circle 428]

Your local library. To acquaint engineers with surface-mounting technology, *Micro-Min* (for "micro-miniaturization of circuit assemblies"), AWI, and Allen-Bradley Co. Components Group have jointly issued the *Micro-Min Component Library.* This spiral-bound softcover book lets the user examine passive and active components and includes part numbers, specifications, descriptions, and packaging. Vendors are also listed. The copyrighted volume is available for $350 (single-copy price) from AWI, 558 Oakmead Pkwy., Sunnyvale, Calif. 94086. [Circle 425]



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May 6	The Realities of Voice and Data Integration
May 13	The Multi-Billion Dollar Field Service Business
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May 27	Computer Graphics Trends

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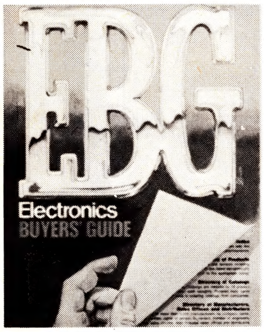

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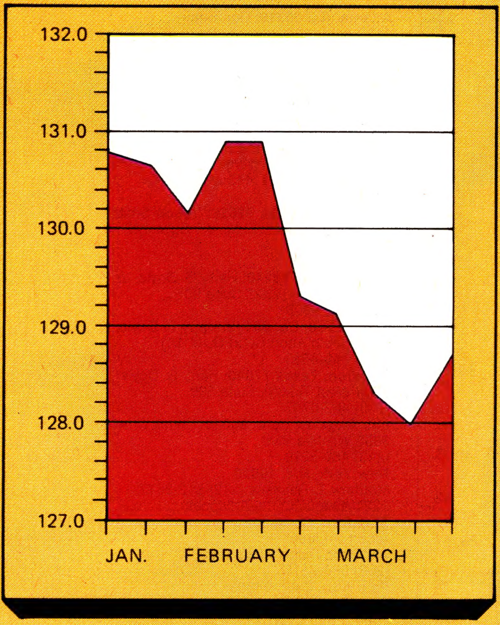
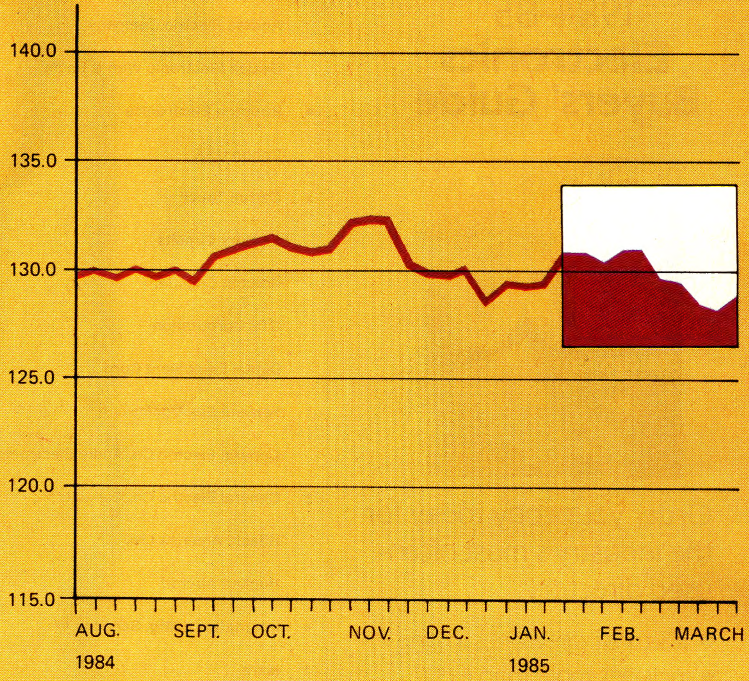
ElectronicsWeek Index



THIS WEEK = 128.7
LAST WEEK = 128.0
YEAR AGO = 124.8
1982 = 100.0



The *ElectronicsWeek* Index, a seasonally adjusted measure of the U.S. electronics industry's health, is a weighted average of various indicators. Different indicators will appear from week to week.

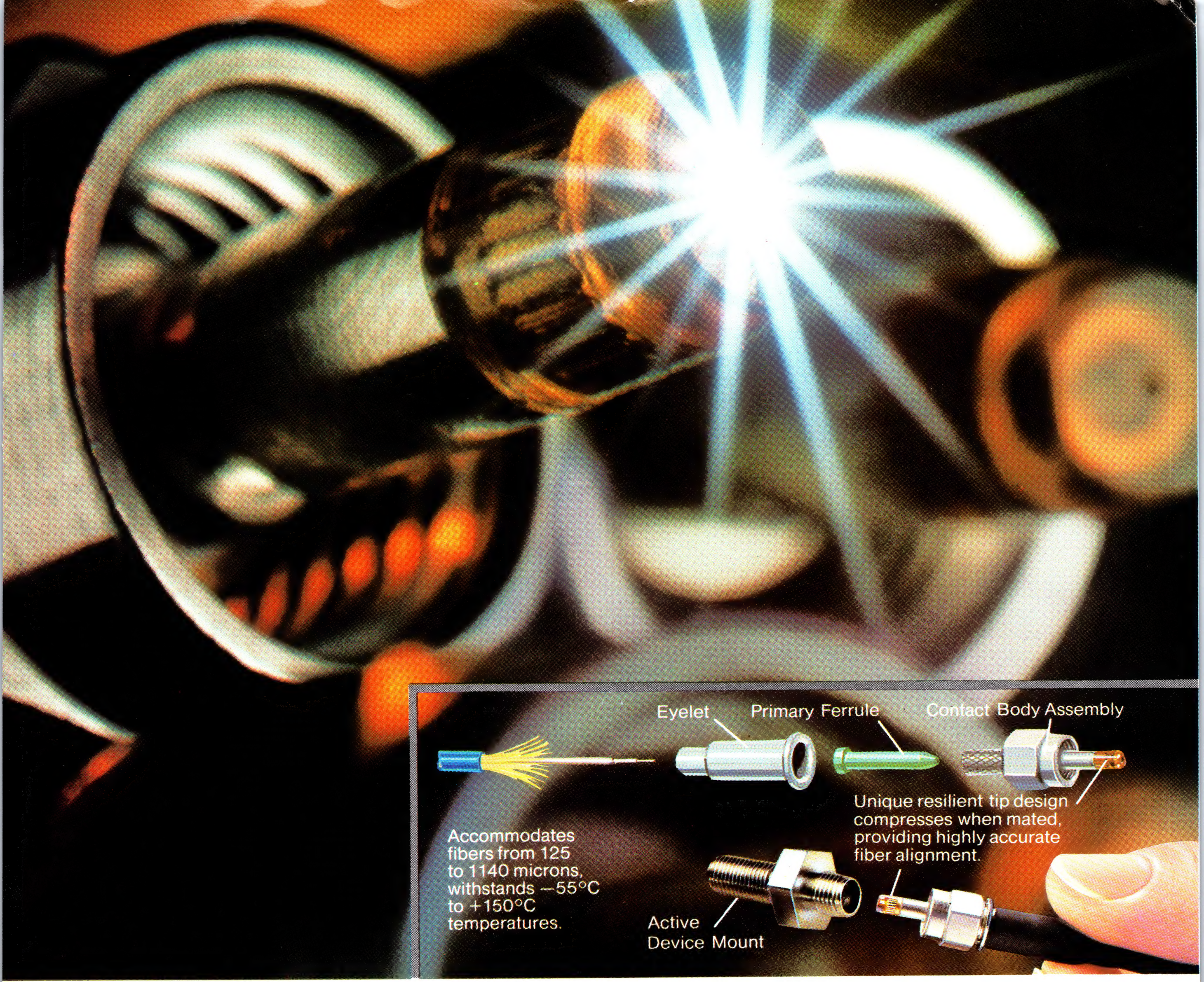
U.S. ELECTRONICS INDUSTRY SHIPMENTS

Shipments ($ billions)	February 1985	January 1985	February 1984
Communications equipment	5.201	4.782	4.209
Radio and TV receiving equipment	0.904	0.983	0.782
Electronic and electrical instruments	4.874	4.778	4.426
Components	3.430	3.436	3.500

U.S. GENERAL ECONOMIC INDICATORS

	February 1985	January 1985	February 1984
Index of leading economic indicators	167.5	166.4	166.5
Budgeted outlays of the federal government ($ billions)	74.851	76.838	68.267
Budgeted outlays of the Department of Defense ($ billions)	19.785	19.367	18.515
Operating rate of all industries (% capacity)	79.1	79.5	79.4
Industrial-production index	164.7	165.5	160.0
Total housing starts (annual rate in thousands)	1,638	1,841	2,208

A spirited rebound in shipments of communications equipment in February helped boost the *ElectronicsWeek* Index by half a point in the latest week. On top of the 8.8% gain for communications gear, shipments of instruments took a 2% hike, but that's where the fanfare stops. Shipments of radio and TV equipment plummeted 8%, the most severe decline since shipments dropped over 16% last June. Component shipments declined 2% in February, a mild drop compared with January's 12% crash.



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Accommodates fibers from 125 to 1140 microns, withstands −55°C to +150°C temperatures.

SIMPLE AND ACCURATE.

The FSMA fiber optic connector with a nose for superior performance.

The nose is the news in our newest fiber optic idea.

The precision resilient tip on our FSMA OPTIMATE connector minimizes tolerance problems, accurately centering the fiber during mating without special procedures, without extra parts. And the internal-ferrule construction provides two-point support and axial alignment to within 0.1 degree for remarkably low insertion loss.

Need a rugged package? Corrosion resistant metal construction provides high strength. Simplified bonding minimizes fiber stress in extreme temperatures. And the overall design meets proposed NATO and IEC standards for FSMA type fiber optic connectors.

The result is everything you're looking for in a light connection. The FSMA connector that's simple. Precise. And available right now.

For more information, call the AMP OPTIMATE Desk at (717) 780-4400. AMP Incorporated, Harrisburg, PA 17105.

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Circle 901 on reader service card

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Since GE's peripherals are compatible with most home computers, you don't have to carry a variety of brands to match your computer lines. We designed Interfaces for use with various Atari® and Commodore® home computers as well as the IBM® PCjr. Compatibility means profitability and broader consumer appeal.

FULL LINE VALUE.

GE peripherals provide value by offering features and benefits consumers want. Like the letter quality Printer with graphics capabilities. Color and monochrome Monitors that double as high performance televisions. A Modem that has both acoustic and direct connection to telephone systems, and a Data Recorder that's omni-compatible. All designed to fit home computer needs tomorrow as well as today.

QUALITY THAT WON'T QUIT.

GE peripherals are built to last. For instance, the Printer has been designed for over 20 million impressions and run for over one thousand, five hundred hours.

The Modem has been subjected to rigorous drop testing and the Data Recorder has been designed for day in, day out rugged use. This is why we can offer full two-year warranties on the Printer and Modem, and a full one-year warranty on the Data Recorder.

In addition, the GE Answer Center™ is always available to assist you or your customers 24 hours a day.

FOR MORE INFORMATION:

Contact your GE sales representative or call the new GE Business Information Center at (518) 438-6500 for more information on "The Quality Connection"

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13" Color Monitor/TV

Model 3-8100
Letter Quality Printer

Model 3-5156
Data Recorder

Model 3-8200
Modem

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